From: [redacted]
To: Title VI Complaints
Subject: Take Action: James L Braddock North Hudson County Park
Date: Tuesday, April 14, 2015 5:43:36 PM
Attachments: WP_20150411_19_03_41_Pro.jpg
WP_20150411_19_03_51_Pro.jpg
WP_20150411_19_03_52_Pro.jpg
WP_20150411_19_03_58_Pro.jpg
WP_20150411_19_04_05_Pro.jpg
WP_20150411_19_04_20_Pro.jpg
WP_20150411_19_04_30_Pro.jpg
WP_20150411_19_05_32_Pro.jpg
WP_20150411_19_05_38_Pro.jpg
WP_20150411_19_09_54_Pro.jpg

Dear Mrs/Mr:

I'm writing this electronic mail because I would like to demonstrate my concern with the water in the James L. Braddock North Hudson County Park. I'm a citizen preoccupy with the contamination the water of this park since it could be causing wild life to die or to migrate to different places. I was stunned when I saw a couple of tortoises; I though they were beautiful. But as I looked closer, I noticed they were all dead.

There are other people who are also concern with the contamination of this park. Many people who walk the park noticed dead animals, especially dead tortoises. Therefore, the reports from talking to different people suggest that there is something happening to the life of the animals living in the water.

Now, I take this matter to you in hopes that you could remediate the awful situation that is causing poor animals to die. If you could check the contamination levels the water and other types of tests to determine its condition.

I have attach to this email pictures of the dead animals and site.

I would definitely appreciate your response on this matter.

Sincerely,

(b) (6) Privacy
(b) (6) Privacy

PS. You will see the pictures of the animals that are floating in the water.

From:	Alok Disa
To:	"Lawson, Christine"; Mccarthy, Gina; Title VI Complaints
Cc:	Jocelyn D"Ambrosio; Marianne Engelman Lado
Subject:	RE: RECALL: Exhibits to 09 03 14 DENR Complaint: Exhibits 1 - 26
Date:	Wednesday, April 08, 2015 11:05:17 AM
Attachments:	image001.gif 2014-09-03-DENR Complaint - Exhibit Vol 1 Exs. 1-26-second revision.pdf

Hello Christine,

Thanks for the note. Attached please find a complete version of Exhibit Volume 1, which has the first 26 exhibits in support of the Complaint.

Also, please note that I will be following up in a separate email regarding an outstanding records request with your department. I look forward to your attention that matter.

Thanks again. Please let me know if there's any other help I can provide.

Best,

Alok

From: Lawson, Christine [mailto:Christine.Lawson@ncdenr.gov]
Sent: Tuesday, April 07, 2015 9:10 AM
To: Alok Disa; 'McCarthy.gina@Epa.gov'; 'Title_VI_Complaints@epa.gov'
Subject: RE: RECALL: Exhibits to 09 03 14 DENR Complaint: Exhibits 1 - 26

Alok –

In reviewing these documents, it seems that not all 26 exhibits are in the attachment. I only see up to Exhibit 11 in the 117 pages of this attachment. Can you provide me with the full 26 exhibits that were to be included in this attachment? Feel free to break it up into smaller files if necessary. We need the full documentation for our record and review.

Thank you.

Christine B. Lawson
Program Manager - Animal Feeding Operations
NC Division of Water Resources
919-807-6354 - voice 919-807-6496 – fax

From: Alok Disa [mailto:adisa@earthjustice.org]
Sent: Friday, September 05, 2014 12:34 PM
To: 'McCarthy.gina@Epa.gov'; 'Title_VI_Complaints@epa.gov'
Cc: Jocelyn D'Ambrosio; Marianne Engelman Lado; [redacted] [redacted] 'lbaldwin@waterkeeper.org'; 'wooden-aguilar.helena@epa.gov'; 'tejada.matthew@epa.gov'; 'halim-chestnut.naima@epa.gov'; 'Daria.Neal@usdoj.gov'; Reeder, Tom; Lawson, Christine
Subject: RECALL: Exhibits to 09 03 14 DENR Complaint: Exhibits 1 - 26
Importance: High

Dear Administrator McCarthy, Ms. Golightly-Howell, Ms. Wooden-Aguilar, Mr. Tejada, Ms. McTeer Toney, Ms. Halim-Chestnut, Ms. Neal, Mr. Reeder, and Ms. Lawson:

I am writing to recall Volume 1 of the exhibits supporting the Title VI Complaint (Exhibits 1-26) that we sent to your attention on Wednesday, September 3, 2014, and to provide a revised version of Volume 1 of the exhibits. The September 3rd version of Volume 1 of the exhibits inadvertently included a map as an attachment to Exhibit 5, the Declaration of Anonymous 1. The revised Volume 1 of the exhibits removes the inadvertently included map.

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Please destroy the September 3 version of Volume 1 of the exhibits and any copies that you might have made, and use the attached revision to Volume 1. Please confirm that you have destroyed all copies of the September 3rd version of Volume 1 by replying to this email.
For Administrator McCarthy and Ms. GoLightly-Howell, who received hard copies of Exhibit 1, please destroy the map that accompanied Exhibit 5 and confirm its destruction by replying to this email.
Thank you,
Alok Disa, on behalf of Marianne Engelman Lado and Jocelyn D'Ambrosio

---

From: Alok Disa
Sent: Wednesday, September 03, 2014 7:51 PM
To: 'McCarthy.gina@Epa.gov'; 'Title_VI_Complaints@epa.gov'
Cc: Jocelyn D'Ambrosio; Marianne Engelman Lado; (b) (6) Privacy [redacted] (b) (6) Privacy [redacted] 'lbaldwin@waterkeeper.org'; 'wooden-aguilar.helena@epa.gov'; 'tejada.matthew@epa.gov'; 'halim-chestnut.naima@epa.gov'; 'Daria.Neal@usdoj.gov'; 'tom.reeder@ncdenr.gov'; 'christine.lawson@ncdenr.gov'
Subject: Exhibits to 09 03 14 DENR Complaint: Exhibits 1 – 26

Dear Administrator McCarthy and Ms. Golightly-Howell,
Attached please find Exhibits 1-26, which represent the first set of Exhibits to the Complaint submitted earlier today by Earthjustice on behalf of North Carolina Environmental Justice Network, Rural Empowerment Association for Community Help, and Waterkeeper Alliance, Inc. We apologize for forwarding these exhibits in batches and are forwarding hard copy versions by overnight mail for your convenience.
Please feel free to let us know if these materials raise any question or if you have trouble downloading them.
Sincerely,
Alok Disa, on behalf of Marianne Engelman Lado and Jocelyn D'Ambrosio

____

Alok Disa
Litigation Assistant
Earthjustice Northeast Office
48 Wall Street, 19th Floor
New York, NY 10005
T: 212-845-7386 (direct)
F: 212-918-1556
earthjustice.org

From: [redacted]
Subject: [SPAM] I TRUSTED YOU.....
Date: Saturday, April 18, 2015 10:57:32 AM

I TRUSTED YOU

Hello My Dear,

How are you doing today? I hope that you are doing great. I just want to say hi after reading your profile. I hope you can be trusted ? I have something very important to tell you if you can reply this message as fast as possible because time is no longer on my side. I want to donate $5 million dollars to the charity and poor people through you if possible.

I am suffering from long time Cancer of the breast. From all indications my condition is really deteriorating and its quite obvious that I won't live more than 3 months according to my doctors. This is because the cancer stage has gotten to a very bad stage. I dont want your pity but I need your trust. At this stage all i want is to make some donation to less privileged people through you so that i will die a happy woman, so reply as fast as possible to enable me give you the full details of the whole transaction and procedures with proves and documents that covers the transaction.

You can read more about me and my late husband through this link

(b) (6) Privacy(b) (6) Privacy(b) (6) Privacy [redacted]

Thanks

(b) (6) Privacy [redacted]

Contact me through this email for more details

(b) (6) Privacy(b) (6) Privacy [redacted]

From: [redacted]
Subject: [SPAM] I TRUSTED YOU
Date: Saturday, April 18, 2015 1:47:45 PM

I TRUSTED YOU

Hello My Dear,

How are you doing today? I hope that you are doing great. I just want to say hi after reading your profile. I hope you can be trusted ? I have something very important to tell you if you can reply this message as fast as possible because time is no longer on my side. I want to donate $5 million dollars to the charity and poor people through you if possible.

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Thanks

(b) (6) Privacy

Contact me through this email for more details

(b) (6) Privacy(b) (6) Privacy

From: [redacted]
To: Title VI Complaints
Subject: [SPAM] Payment Code: SESI-1466-2014/HM
Date: Monday, April 13, 2015 6:09:15 PM

Bank Alerts & Notifications!!
Payment Code: SESI-1466-2014/HM

We received a new payment order dated 10th of April, 2015 to transfer $500.000.00 to you, from Turki bin Nasser, [redacted] of Saudi Environment Society. A donation board of Saudi Environmental Society (SENS). We wish to inform you that one Mr. [redacted], with address [redacted], came to our office last week saying you signed an agreement giving him the legal rights and privileges to claim your funds in the tune of $500,000.00 USD. Sequel to this effect, Your ATM DEBIT CARD has been successfully loaded with a payment of your $500,000.00 USD, your ATM DEBIT CARD should not be tampered with by any of The Saudi Environmental Society (SENS) official since it has been approved by the board of Saudi Environmental Society (SENS) that the exact funds must be delivered to your designated address via the FedEx or UPS Courier Service without any deduction made on it.

Here comes the question:
1.Did you assign or Signed an agreement in his favor?
2.Do you know [redacted] If your answer is No

You are therefore given 24 hrs by the Saudi Environmental Society (SENS)to confirm the truth in this information, you are to contact us back immediately, be cause we work 24 hrs just to ensure that we monitor all the activities going on in regards to the transfer of this fund. We await your answer as urgency implies, for further explanations and effective communication call [redacted] (Supervisor Investigation and Debt Settlement), Tel: [redacted] acquainted for all the unclaimed fund Debt Management Account Deposit Facility (DMADF) office ledgers issues ASAP

Waiting for your response

Board of directors

[redacted] of Saudi Environmental Society (SENS)
[redacted]

From:	Lawson, Christine
To:	Alok Disa; Mccarthy, Gina; Title VI Complaints
Subject:	RE: RECALL: Exhibits to 09 03 14 DENR Complaint: Exhibits 1 - 26
Date:	Tuesday, April 07, 2015 9:10:16 AM
Attachments:	image001.gif

Alok –

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Thank you.

Christine B. Lawson

Program Manager - Animal Feeding Operations

NC Division of Water Resources

919-807-6354 - voice 919-807-6496 – fax

From: Alok Disa [mailto:adisa@earthjustice.org]
Sent: Friday, September 05, 2014 12:34 PM
To: 'McCarthy.gina@Epa.gov'; 'Title_VI_Complaints@epa.gov'
Cc: Jocelyn D'Ambrosio; Marianne Engelman Lado; [redacted] [redacted] 'lbaldwin@waterkeeper.org'; 'wooden-aguilar.helena@epa.gov'; 'tejada.matthew@epa.gov'; 'halim-chestnut.naima@epa.gov'; 'Daria.Neal@usdoj.gov'; Reeder, Tom; Lawson, Christine
Subject: RECALL: Exhibits to 09 03 14 DENR Complaint: Exhibits 1 - 26
Importance: High

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Cc: Jocelyn D'Ambrosio; Marianne Engelman Lado; [redacted]'; 'djhall7@aol.com'; 'lbaldwin@waterkeeper.org'; 'wooden-aguilar.helena@epa.gov'; 'tejada.matthew@epa.gov'; 'halim-chestnut.naima@epa.gov'; 'Daria.Neal@usdoj.gov'; 'tom.reeder@ncdenr.gov'; 'christine.lawson@ncdenr.gov'
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Please feel free to let us know if these materials raise any question or if you have trouble downloading them.

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---

Alok Disa
Litigation Assistant
Earthjustice Northeast Office
48 Wall Street, 19th Floor
New York, NY 10005
T: 212-845-7386 (direct)
F: 212-918-1556
earthjustice.org

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Sent: Tuesday, April 07, 2015 9:10 AM
To: Alok Disa; 'McCarthy.gina@Epa.gov'; 'Title_VI_Complaints@epa.gov'
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Litigation Assistant
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earthjustice.org

Complaint of North Carolina Environmental Justice Network, Rural Empowerment Association for Community Help, and Waterkeeper Alliance, Inc. under Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d and 40 C.F.R. Part 7

against

North Carolina Department of Environment and Natural Resources

filed with

the United States Environmental Protection Agency

SUPPORTING EXHIBITS

VOLUME 1 OF 3
EXHIBITS 1-26

Filed: September 3, 2014

Complaint of North Carolina Environmental Justice Network, Rural Empowerment Association for Community Help, and Waterkeeper Alliance, Inc. under Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d and 40 C.F.R. Part 7

Exhibits

Volume 1 of 3 Exhibits 1-26	
Exhibit 1.A	EPA Award of Federal Funds to DENR in Fiscal Year 2014
Exhibit 1.B	EPA Awards of Federal Funds to DENR Extending into Fiscal Year 2014 and Thereafter
Exhibit 2	Comments of Steve Wing, Ginger T. Guidry, Sarah Hatcher, and Jessica Rinsky, on General Permit AWG100000, December 6, 2013
Exhibit 3	Comments of Catawba Riverkeeper Foundation, Cape Fear River Watch, Neuse Riverkeeper Foundation, North Carolina Environmental Justice Network, Pamlico-Tar River Foundation, Waterkeepers Carolina, Western North Carolina Alliance, Winyah Rivers Foundation, and Yadkin Riverkeeper, Inc. on Renewal of North Carolina State General Permits to Control Animal Waste, AWG100000 (Swine Waste Management System General Permit), AWG200000 (Cattle Waste Management System General Permit), AWG300000 (Poultry Waste Management System), submitted by Earthjustice, Waterkeeper Alliance, Inc. and Southern Environmental Law Center, December 6, 2013 (with Exs. 1-3)
Exhibit 4	Steve Wing & Jill Johnston, Dep't of Epidemiology, Univ. of N.C. at Chapel Hill, Industrial Hog Operations in North Carolina Disproportionately Impact People of Color (2014)
Exhibit 5	Anonymous Declaration I
Exhibit 6	Declaration of [redacted] Exhibit 1 Biography Exhibit 2 Photograph of Runoff from Hog Facility, Duplin County (Jan. 2012) Exhibit 3 Photograph of Runoff from Hog Facility, Duplin County (March 2013) Exhibit 4 Photograph of Runoff from Hog Facility, Greene County (March 2013) Exhibit 5 Photograph of Gully, Beaufort County (Aug. 2013) Exhibit 6 Photograph of Gully, Beaufort County (Aug. 2013) Exhibit 7 Photograph of Gully, Duplin County (Feb. 2014) Exhibit 8 Photograph of Dead Box, Craven County (Feb. 2014)

	Exhibit 9 Photograph of Dead Box, Jones County (Feb. 2014) Exhibit 10 Photograph of Buried Hogs Exhibit 11 Photograph of Buried Hogs Exhibit 12 Envirochem Water Quality Monitoring Report (Feb. 2014) Exhibit 13 Envirochem Water Quality Monitoring Report (Feb. 2014) Exhibit 14 Envirochem Water Quality Monitoring Report (Feb. 2014) Exhibit 15 Envirochem Water Quality Monitoring Report (Feb. 2014) Exhibit 16 Envirochem Water Quality Monitoring Report (Feb. 2014) Exhibit 17 Michael A. Mallin, Stocking Head Creek Fecal Coliform Bacteria Investigation (Jan. 28, 2014) (unpublished report submitted to Waterkeeper Alliance)
Exhibit 7	Declaration of [redacted]. Exhibit 1 Map Showing Hog Facilities Near Home Exhibit 2 Map Showing Hog Facilities Near Other Property
Exhibit 8	Declaration of [redacted] (with map)
Exhibit 9	Declaration of [redacted] (with map)
Exhibit 10	Declaration of [redacted] (with map)
Exhibit 11	Declaration of [redacted] (with map)
Exhibit 12	Declaration of [redacted] (with map)
Exhibit 13	Declaration of [redacted] (with map)
Exhibit 14	Declaration of JoAnn Burkholder Exhibit 1 Curriculum Vitae Exhibit 2 JoAnn Burkholder et al., *Impacts to a Coastal River and Estuary from Rupture of a Large Swine Waste Holding Lagoon*, 26 J. Envtl. Qual. 1451 (1997) Exhibit 3 JoAnn Burkholder et al., *Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality*, 115 Envtl. Health Perspectives 308 (2007)
Exhibit 15	Declaration of [redacted] (with map)
Exhibit 16	Declaration of [redacted]

Exhibit 17	Declaration of [redacted] Exhibit 1 Map Showing Home and Partial Property Boundary Exhibit 2 Map Showing Home and Nearby Sprayfields and Hog Houses Exhibit 3 Map Showing Hog Facility in Relation to Relatives' Homes
Exhibit 18	Declaration of [redacted] Exhibit 1 Map Showing Hog Facilities in Vicinity of Church
Exhibit 19	Declaration of [redacted] (with map)
Exhibit 20	Declaration of [redacted] (with map)
Exhibit 21	Declaration of [redacted] (with map)
Exhibit 22	Declaration of [redacted] (with map)
Exhibit 23	Declaration of [redacted] (with map)
Exhibit 24	Declaration of [redacted] Exhibit 1 Map Showing Home and Nearby Hog Facilities
Exhibit 25	Declaration of [redacted] Exhibit 1 Map Showing Home and Church Exhibit 2 Map Showing Home, Church and Nearest Hog Facility Exhibit 3 Map Showing Hog Facilities Along [redacted]. Exhibit 4 Map Showing Hog Facilities Within Three Miles of Home
Exhibit 26	Declaration of [redacted] Exhibit 1 Map Showing Hog Facilities Near [redacted] Exhibit 2 Map Showing Hog Facilities Near [redacted] Exhibit 3 Map Showing Hog Facilities Near High School

Volume 2 of 3 Exhibits 27-45	
Exhibit 27	Declaration of [redacted] (with map)
Exhibit 28	Declaration of [redacted] (with map)
Exhibit 29	Declaration of [redacted] Exhibit 1 Map Showing Home and Nearby Hog Houses, Lagoon and Sprayfield
Exhibit 30	Declaration of [redacted] Exhibit 1 The Rest of the Story: Corporate Hog Farming in North Carolina (DVD) Exhibit 2 Map Showing Hog Facilities Operating under North Carolina's General Permit in Duplin, Sampson, Bladen, Northampton, Greene and Pender Counties
Exhibit 31	Declaration of [redacted] (with map)
Exhibit 32	Declaration of [redacted] (with map)
Exhibit 33	Declaration of [redacted] (with map)
Exhibit 34	Declaration of [redacted] (with map)
Exhibit 35	Declaration of [redacted] Exhibit 1 Map Showing Sprayfields Around Home Exhibit 2 Map Showing Permitted Hog Facilities Near Home Exhibit 3 Map Showing Hog Facilities Within Three Miles of Home
Exhibit 36	Declaration of [redacted] (with map)
Exhibit 37	M.E. Anderson & M.D. Sobsey, *Detection and Occurrence of Antimicrobially Resistant E. coli in Groundwater on or near Swine Farms in Eastern North Carolina*, 54 Water Sci. & Tech. 211 (2006)
Exhibit 38	Blue Ribbon Study Commission on Agricultural Waste, Report to the 1995 General Assembly of North Carolina, 1996 Regular Session (1996)
Exhibit 39	Dana Cole et al., *Concentrated Swine Feeding Operations and Public Health: A Review of Occupational and Community Health Effects*, 108 Envtl. Health Perspectives 685 (2000)

Exhibit 40	Carrie Hribar, Nat'l Ass's of Local Bds. of Health, Understanding Concentrated Animal Feeding Operations and Their Impact on Communities (2010)
Exhibit 41	Michael A. Mallin & Lawrence B. Cahoon, *Industrialized Animal Production—A Major Source of Nutrient and Microbial Pollution to Aquatic Ecosystems*, 24 Population & Env't 369 (2003)
Exhibit 42	Maria C. Mirabelli et al., *Asthma Symptoms Among Adolescents Who Attend Public Schools That Are Located Near Confined Swine Feeding Operations*, 118 Pediatrics e66 (2006)
Exhibit 43	Maria C. Mirabelli et al., *Race, Poverty, and Potential Exposure of Middle-School Students to Air Emissions from Confined Swine Feeding Operations*, 114 Envtl. Health Perspectives 591 (2006)
Exhibit 44	Wendee Nicole, *CAFOs and Environmental Justice: The Case of North Carolina*, 121 Envtl. Health Perspectives A182 (2013)
Exhibit 45	Pew Commission on Industrial Farm Animal Production, Environmental Impact of Industrial Farm Animal Production (2008)

Volume 3 of 3 Exhibits 46-53	
Exhibit 46	Pew Commission on Industrial Farm Animal Production, Putting Meat on the Table: Industrial Farm Animal Production in America (2008)
Exhibit 47	RTI International, Benefits of Adopting Environmentally Superior Swine Waste Management Technologies in North Carolina: An Environmental and Economic Assessment (2003)
Exhibit 48	Leah Schinasi et al., *Air Pollution, Lung Function, and Physical Symptoms in Communities Near Concentrated Animal Feeding Operations*, 22 Epidemiology 208 (2011)
Exhibit 49	Sacoby M. Wilson & Marc L. Serre, *Examination of Atmospheric Ammonia Levels Near Hog CAFOs, Homes, and Schools in Eastern North Carolina*, 41 Atmospheric Env't 4977 (2007)
Exhibit 50	Steve Wing et al., *Air Pollution and Odor in Communities Near Industrial Swine Operations*, 116 Envtl. Health Perspectives 1362 (2008)
Exhibit 51	Steve Wing et al., *Air Pollution from Industrial Swine Operations and Blood Pressure of Neighboring Residents*, 121 Envtl. Health Perspectives 92 (2013)
Exhibit 52	Steve Wing et al., *Environmental Injustice in North Carolina's Hog Industry*, 108 Envtl. Health Perspectives 225 (2000)
Exhibit 53	Steve Wing & Susanne Wolf, *Intensive Livestock Operations, Health, and Quality of Life Among Eastern North Carolina Residents*, 108 Envtl. Health Perspectives 233 (2000)

Exhibit 1

Exhibit 1.A
EPA Award of Federal Funds to DENR in Fiscal Year 2014

Unique Federal Award ID	Federal Funding Amount	Award Type	Action Type	Obligation/Action Date	Award Start Date	Award End Date	Program
95495712 2	$0	Project grant	Continuation	10/22/2013	7/1/2012	12/31/2014	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
83605801 1	$0	Project grant	Continuation	11/22/2013	10/1/2011	9/30/2014	Environmental Information Exchange Network Grant Program and Related Assistance
00429614 0	$804,816	Formula grant	New Assistance	11/26/2013	10/1/2013	9/30/2014	State Public Water System Supervision
00406914 0	$552,815	Project grant	New Assistance	12/3/2013	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
83410601 4	$0	Project grant	Continuation	12/6/2013	9/1/2008	9/30/2014	Environmental Information Exchange Network Grant Program and Related Assistance
00406010 A	$806,521	Formula grant	Continuation	12/17/2013	10/1/2009	9/30/2014	Air Pollution Control Program Support
00435614 0	$26,270	Formula grant	New Assistance	12/20/2013	10/1/2013	9/30/2014	State Underground Water Source Protection
95471711 8	$1,603,096	Formula grant	Continuation	12/20/2013	10/1/2010	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
97470914 0	$89,000	Formula grant	New Assistance	12/20/2013	10/1/2013	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00477111 6	$100,000	Formula grant	Continuation	12/20/2013	10/1/2010	9/30/2015	Water Quality Management Planning
95471211 1	$0	Cooperative agreement	Continuation	1/21/2014	1/1/2011	3/31/2014	Regional Wetland Program Development Grants
95449910 4	$0	Cooperative agreement	Continuation	1/23/2014	2/1/2010	6/30/2014	Regional Wetland Program Development Grants
00406914 1	$542,191	Project grant	Continuation	2/7/2014	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
83492701 3	$0	Project grant	Continuation	3/5/2014	3/1/2011	6/30/2015	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
00406914 2	$1,127,887	Project grant	Continuation	3/12/2014	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
95451210 5	$0	Project grant	Continuation	3/21/2014	10/1/2009	9/30/2016	National Estuary Program
00429614 1	$2,337,184	Formula grant	Continuation	4/1/2014	10/1/2013	9/30/2014	State Public Water System Supervision
95485012 4	$0	Project grant	Continuation	4/4/2014	10/1/2011	9/30/2013	Superfund State and Indian Tribe Core Program Cooperative Agreements
00406010 B	$1,430,170	Formula grant	Continuation	4/11/2014	10/1/2009	9/30/2014	Air Pollution Control Program Support
00435614 1	$51,730	Formula grant	Continuation	4/24/2014	10/1/2013	9/30/2014	State Underground Water Source Protection
95414314 0	$750,000	Project grant	New Assistance	5/2/2014	10/1/2013	9/30/2015	Underground Storage Tank Prevention, Detection and Compliance Program
96496808 8	$680,000	Project grant	Continuation	5/7/2014	4/1/2008	3/31/2015	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
97470914 1	$960,000	Formula grant	Continuation	5/15/2014	10/1/2013	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00D12314 0	$2,000,000	Project grant	New Assistance	5/22/2014	10/1/2013	9/30/2015	Leaking Underground Storage Tank Trust Fund Corrective Action Program
95485014 1	$67,868	Project grant	Continuation	5/27/2014	10/1/2013	9/30/2015	Superfund State and Indian Tribe Core Program Cooperative Agreements
95485214 1	$236,241	Project grant	Continuation	5/27/2014	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
95485114 1	$152,190	Project grant	Continuation	5/27/2014	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
00429614 2	$6,000	Formula grant	Continuation	6/3/2014	10/1/2013	9/30/2014	State Public Water System Supervision
00406914 3	$47,355	Project grant	Continuation	6/19/2014	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
00D12314 1	$254,117	Project grant	Continuation	6/25/2014	10/1/2013	9/30/2015	Leaking Underground Storage Tank Trust Fund Corrective Action Program
95471711 9	$4,340,904	Formula grant	Continuation	6/25/2014	10/1/2010	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00D01312 1	$0	Cooperative agreement	Continuation	7/10/2014	1/1/2013	3/31/2016	Regional Wetland Program Development Grants
00477111 7	$156,000	Formula grant	Continuation	7/31/2014	11/5/2010	9/30/2015	Water Quality Management Planning
95449910 5	$0	Cooperative agreement	Continuation	8/6/2014	2/1/2010	6/30/2015	Regional Wetland Program Development Grants
95488411 2	$0	Cooperative agreement	Continuation	8/6/2014	10/1/2011	3/31/2015	Regional Wetland Program Development Grants
00D20714 0	$160,000	Formula grant	New Assistance	8/15/2014	10/1/2014	9/30/2016	Water Pollution Control State, Interstate, and Tribal Program Support

Total Funding Dispersed in FY	$19,282,355
New Assistance	$4,382,901
Continuation	$14,899,454

This data was recorded from *usaspending.gov* on August 27, 2014.
Fiscal Year 2014 begins on October 1, 2013 and extends through September 30, 2014.

Exhibit 1.B
EPA Awards of Federal Funds to DENR Extending into Fiscal Year 2014 and Thereafter

Unique Federal Award ID	Federal Funding Amount	Award Type	Action Type	Obligation/Action Date	Award Start Date	Award End Date	Program
97470909 B	$0	Formula grant	Continuation	9/4/2013	10/1/2008	1/31/2014	Water Pollution Control State, Interstate, and Tribal Program Support
96496808 6	$320,127	Project grant	Continuation	3/29/2013	4/1/2008	3/31/2014	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
96496808 7	$359,873	Project grant	Continuation	6/28/2013	4/1/2008	3/31/2014	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
96450912 1	$0	Project grant	Continuation	9/30/2013	10/1/2011	3/31/2014	Leaking Underground Storage Tank Trust Fund Corrective Action Program
95471211 1	$0	Cooperative agreement	Continuation	1/21/2014	1/1/2011	3/31/2014	Regional Wetland Program Development Grants
00D01312 0	$272,408	Cooperative agreement	New Assistance	8/29/2012	1/1/2013	6/30/2014	Regional Wetland Program Development Grants
00D16413 0	$283,800	Project grant	New Assistance	9/26/2013	7/1/2013	6/30/2014	Beach Monitoring and Notification Program Implementation Grants
95449910 4	$0	Cooperative agreement	Continuation	1/23/2014	2/1/2010	6/30/2014	Regional Wetland Program Development Grants
98433808 0	$27,414,000	Project grant	New Assistance	8/24/2009	7/1/2009	9/13/2014	Capitalization Grants for Drinking Water State Revolving Funds
98433808 1	$0	Formula grant	Continuation	6/13/2013	7/1/2009	9/13/2014	Capitalization Grants for Drinking Water State Revolving Funds
37000111 0	$26,650,000	Project grant	New Assistance	12/13/2011	10/1/2011	9/30/2014	Capitalization Grants for Clean Water State Revolving Funds
95471711 3	$1,045,551	Project grant	Continuation	1/18/2012	10/1/2010	9/30/2014	Water Pollution Control State, Interstate, and Tribal Program Support
95471711 4	$4,797,234	Project grant	Continuation	4/3/2012	10/1/2010	9/30/2014	Water Pollution Control State, Interstate, and Tribal Program Support
37000111 1	$0	Formula grant	Continuation	5/18/2012	10/1/2011	9/30/2014	Capitalization Grants for Clean Water State Revolving Funds
95471711 5	$297,615	Project grant	Continuation	6/22/2012	10/1/2010	9/30/2014	Water Pollution Control State, Interstate, and Tribal Program Support
95493912 0	$0	Formula grant	New Assistance	8/15/2012	1/6/2012	9/30/2014	Water Pollution Control State, Interstate, and Tribal Program Support
95494011 0	$173,200	Formula grant	New Assistance	8/15/2012	1/6/2012	9/30/2014	Water Pollution Control State, Interstate, and Tribal Program Support
83492701 1	$0	Project grant	Continuation	1/10/2013	3/1/2011	9/30/2014	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
00406010 8	$1,339,535	Formula grant	Continuation	1/23/2013	10/1/2009	9/30/2014	Air Pollution Control Program Support
00477111 4	$100,000	Formula grant	Continuation	2/19/2013	10/1/2010	9/30/2014	Water Quality Management Planning
95488411 1	$0	Cooperative agreement	Continuation	6/4/2013	10/1/2011	9/30/2014	Regional Wetland Program Development Grants
96488511 1	$0	Cooperative agreement	Continuation	6/4/2013	10/1/2011	9/30/2014	Regional Wetland Program Development Grants
00406010 9	$1,134,169	Formula grant	Continuation	7/10/2013	10/1/2009	9/30/2014	Air Pollution Control Program Support
00477111 5	$143,000	Formula grant	Continuation	7/24/2013	10/1/2010	9/30/2014	Water Quality Management Planning
83492701 2	$108,875	Project grant	Continuation	8/14/2013	3/1/2011	9/30/2014	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
00D00712 1	$131,358	Formula grant	Continuation	8/15/2013	10/1/2012	9/30/2014	State Clean Diesel Grant Program
95451210 4	$512,000	Project grant	Continuation	8/27/2013	10/1/2009	9/30/2014	National Estuary Program
00D12313 0	$1,922,000	Project grant	New Assistance	9/5/2013	10/1/2012	9/30/2014	Leaking Underground Storage Tank Trust Fund Corrective Action Program
98497213 0	$85,000	Project grant	New Assistance	9/9/2013	10/1/2013	9/30/2014	Pollution Prevention Grants Program
00D01912 1	$762,099	Project grant	Continuation	9/24/2013	10/1/2012	9/30/2014	State and Tribal Response Program Grants
83605801 1	$0	Project grant	Continuation	11/22/2013	10/1/2011	9/30/2014	Environmental Information Exchange Network Grant Program and Related Assistance
00429614 0	$804,816	Formula grant	New Assistance	11/26/2013	10/1/2013	9/30/2014	State Public Water System Supervision
00406914 0	$552,815	Project grant	New Assistance	12/3/2013	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
83410601 4	$0	Project grant	Continuation	12/6/2013	9/1/2008	9/30/2014	Environmental Information Exchange Network Grant Program and Related Assistance
00406010 A	$806,521	Formula grant	Continuation	12/17/2013	10/1/2009	9/30/2014	Air Pollution Control Program Support
00435614 0	$26,270	Formula grant	New Assistance	12/20/2013	10/1/2013	9/30/2014	State Underground Water Source Protection
00406914 1	$542,191	Project grant	Continuation	2/7/2014	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
00406914 2	$1,127,887	Project grant	Continuation	3/12/2014	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
00429614 1	$2,337,184	Formula grant	Continuation	4/1/2014	10/1/2013	9/30/2014	State Public Water System Supervision
00406010 B	$1,430,170	Formula grant	Continuation	4/11/2014	10/1/2009	9/30/2014	Air Pollution Control Program Support
00435614 1	$51,730	Formula grant	Continuation	4/24/2014	10/1/2013	9/30/2014	State Underground Water Source Protection
00429614 2	$6,000	Formula grant	Continuation	6/3/2014	10/1/2013	9/30/2014	State Public Water System Supervision
00406914 3	$47,355	Project grant	Continuation	6/19/2014	10/1/2013	9/30/2014	Hazardous Waste Management State Program Support
99465710 0	$4,491,600	Project grant	Continuation	8/17/2010	10/1/2009	12/31/2014	Nonpoint Source Implementation Grants
99465710 1	$257,471	Project grant	Continuation	9/30/2011	10/1/2009	12/31/2014	Nonpoint Source Implementation Grants
37000112 0	$25,507,000	Formula grant	New Assistance	2/6/2013	8/1/2012	12/31/2014	Capitalization Grants for Clean Water State Revolving Funds

Exhibit 1.B
EPA Awards of Federal Funds to DENR Extending into Fiscal Year 2014 and Thereafter

Unique Federal Award ID	Federal Funding Amount	Award Type	Action Type	Obligation/Action Date	Award Start Date	Award End Date	Program
95495712 2	$0	Project grant	Continuation	10/22/2013	7/1/2012	12/31/2014	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
96496808 8	$680,000	Project grant	Continuation	5/7/2014	4/1/2008	3/31/2015	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
95488411 2	$0	Cooperative agreement	Continuation	8/6/2014	10/1/2011	3/31/2015	Regional Wetland Program Development Grants
83492701 3	$0	Project grant	Continuation	3/5/2014	3/1/2011	6/30/2015	Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act
95449910 5	$0	Cooperative agreement	Continuation	8/6/2014	2/1/2010	6/30/2015	Regional Wetland Program Development Grants
98433809 0	$27,414,000	Project grant	Continuation	9/28/2010	7/1/2010	9/13/2015	Capitalization Grants for Drinking Water State Revolving Funds
98433809 1	$0	Formula grant	Continuation	6/13/2013	7/1/2010	9/13/2015	Capitalization Grants for Drinking Water State Revolving Funds
00D01512 0	$258,651	Cooperative agreement	New Assistance	8/24/2012	10/1/2012	9/30/2015	Regional Wetland Program Development Grants
00D04112 0	$259,444	Formula grant	New Assistance	8/30/2012	10/1/2012	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00D04213 0	$0	Formula grant	New Assistance	8/30/2012	10/1/2012	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
95471711 6	$3,242,610	Formula grant	Continuation	12/18/2012	10/1/2010	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
95471711 7	$2,577,290	Formula grant	Continuation	7/16/2013	10/1/2010	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00D04112 1	$65,856	Formula grant	Continuation	7/29/2013	10/1/2012	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
95414308 4	$945,000	Project grant	Continuation	8/21/2013	7/1/2008	9/30/2015	Underground Storage Tank Prevention, Detection and Compliance Program
95485414 0	$24,750	Project grant	New Assistance	9/26/2013	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
95485014 0	$82,949	Project grant	New Assistance	9/27/2013	10/1/2013	9/30/2015	Superfund State and Indian Tribe Core Program Cooperative Agreements
95485114 0	$186,009	Project grant	New Assistance	9/27/2013	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
95485214 0	$288,739	Project grant	New Assistance	9/30/2013	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
95471711 8	$1,603,096	Formula grant	Continuation	12/20/2013	10/1/2010	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
97470914 0	$89,000	Formula grant	New Assistance	12/20/2013	10/1/2013	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00477111 6	$100,000	Formula grant	Continuation	12/20/2013	10/1/2010	9/30/2015	Water Quality Management Planning
95414314 0	$750,000	Project grant	New Assistance	5/2/2014	10/1/2013	9/30/2015	Underground Storage Tank Prevention, Detection and Compliance Program
97470914 1	$960,000	Formula grant	Continuation	5/15/2014	10/1/2013	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00D12314 0	$2,000,000	Project grant	New Assistance	5/22/2014	10/1/2013	9/30/2015	Leaking Underground Storage Tank Trust Fund Corrective Action Program
95485014 1	$67,868	Project grant	Continuation	5/27/2014	10/1/2013	9/30/2015	Superfund State and Indian Tribe Core Program Cooperative Agreements
95485114 1	$152,190	Project grant	Continuation	5/27/2014	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
95485214 1	$236,241	Project grant	Continuation	5/27/2014	10/1/2013	9/30/2015	Superfund State, Political Subdivision, and Indian Tribe Site Specific Cooperative Agreements
00D12314 1	$254,117	Project grant	Continuation	6/25/2014	10/1/2013	9/30/2015	Leaking Underground Storage Tank Trust Fund Corrective Action Program
95471711 9	$4,340,904	Formula grant	Continuation	6/25/2014	10/1/2010	9/30/2015	Water Pollution Control State, Interstate, and Tribal Program Support
00477111 7	$156,000	Formula grant	Continuation	7/31/2014	11/5/2010	9/30/2015	Water Quality Management Planning
99465711 0	$3,902,000	Project grant	New Assistance	9/8/2011	10/1/2010	12/31/2015	Nonpoint Source Implementation Grants
37000113 0	$24,096,000	Formula grant	New Assistance	9/11/2013	8/1/2013	12/31/2015	Capitalization Grants for Clean Water State Revolving Funds
00D01312 1	$0	Cooperative agreement	Continuation	7/10/2014	1/1/2013	3/31/2016	Regional Wetland Program Development Grants
98433810 0	$35,593,000	Project grant	New Assistance	9/8/2011	7/1/2011	9/30/2016	Capitalization Grants for Drinking Water State Revolving Funds
97455902 4	$132,000	Project grant	Continuation	9/29/2011	7/1/2001	9/30/2016	Congressionally Mandated Projects
95451210 5	$0	Project grant	Continuation	3/21/2014	10/1/2009	9/30/2016	National Estuary Program
00D20714 0	$160,000	Formula grant	New Assistance	8/15/2014	10/1/2014	9/30/2016	Water Pollution Control State, Interstate, and Tribal Program Support
99465712 0	$3,645,000	Formula grant	New Assistance	9/25/2012	10/1/2011	12/31/2016	Nonpoint Source Implementation Grants
98433811 0	$24,698,000	Project grant	New Assistance	5/29/2012	7/1/2012	9/30/2017	Capitalization Grants for Drinking Water State Revolving Funds
98433811 1	$3,367,346	Formula grant	Continuation	12/26/2012	7/1/2012	9/30/2017	Capitalization Grants for Drinking Water State Revolving Funds
99465713 0	$3,455,000	Formula grant	New Assistance	9/24/2013	10/1/2012	9/30/2017	Nonpoint Source Implementation Grants
98433813 0	$22,084,000	Formula grant	New Assistance	8/20/2013	7/1/2013	9/30/2018	Capitalization Grants for Drinking Water State Revolving Funds
98433812 0	$17,467,080	Formula grant	New Assistance	9/11/2013	7/1/2013	9/30/2018	Capitalization Grants for Drinking Water State Revolving Funds

Exhibit 2

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF EPIDEMIOLOGY F 919.966.2089
McGAVRAN-GREENBERG HALL
CAMPUS BOX 7435
CHAPEL HILL, NC 27599-7435

December 6, 2013

Via Email

Christine Lawson
NC Division of Water Resources
Animal Feeding Operations Unit
1636 Mail Service Center
Raleigh, North Carolina 27699-1636
christine.lawson@ncdenr.gov

Re: General Permit AWG100000

Dear Ms. Lawson:

North Carolina's general permits for animal waste management systems at industrial swine operations fail to protect public health and the environment. As noted below, there is a large body of evidence documenting the negative health impacts of industrial swine operations, also known as concentrated animal feeding operations (CAFOs).[1] These negative consequences result from the use of lagoons and spray fields to manage animal waste, non-therapeutic use of antibiotics in swine production, the location of confinements and animal waste in flood plains, and the disproportionate burden of CAFO pollutants on communities that are particularly susceptible due to presence of other environmental exposures and inadequate access to medical services. North Carolina communities rely on the Department of Environment and Natural Resources to protect their air, water, and health, and this protection should apply equally regardless of race and wealth. NC DENR currently fails to meet this responsibility and will continue to fail unless future permits are altered to reduce off-site pollution and increase transparency about animal production activities, and regulations are strictly enforced.

I. Negative Health Impacts of Swine CAFOs

Swine CAFOs with liquid waste management systems release numerous air pollutants including particulate matter, endotoxin (a respiratory irritant and allergen that comes from bacteria), ammonia, hydrogen sulfide (a toxic gas that comes from decomposing feces), and other malodorous chemicals. The air pollutants come from barns that house hundreds or thousands of pigs, from open fecal waste pits, and from fields where the waste is spread. Several decades' worth of research shows that, due to exposures inside these facilities, CAFO workers suffer a range of health problems.[2] More recent research indicates that neighbors of swine CAFOs experience numerous symptoms similar to those seen among workers,

[1] Rather than the strict federal definition we use the term "CAFO" to refer to large livestock operations that house animals in confinement.

[2] D. Cole, L. Todd, and S. Wing, "Concentrated Swine Feeding Operations and Public Health: A Review of Occupational and Community Health Effects," *Environ Health Perspect* 108, no. 8 (2000).

including irritation of the eyes, nose and throat, respiratory symptoms, reduced lung function, and asthma-related symptoms. Swine CAFO neighbors also suffer from negative mood states and reduced quality of life. We summarize this research here, emphasizing studies conducted in North Carolina.

In 2000, researchers published a study showing that neighbors of an eastern North Carolina swine CAFO reported more episodes of headache, runny nose, sore throat, coughing, diarrhea, and burning eyes than residents of comparison areas with a dairy and no CAFO. Swine CAFO neighbors also reported more frequent episodes when they could not open their windows or go outside their homes compared to residents of the comparison areas.[3]

In 2006, researchers published a study showing that students at North Carolina public middle schools located within three miles of swine CAFOs had more asthma-related symptoms, more doctor-diagnosed asthma, and more asthma-related medical visits than students who attended schools further from swine CAFOs. Children attending middle schools where school staff reported that livestock odor was present inside the school twice or more per month had a 23% higher prevalence of wheezing symptoms compared to children who attended schools where no livestock odor was reported.[4] Particles and gases released from swine CAFO liquid waste storage and land application can produce these impacts, which have also been observed in other states.

More recently, investigators set up monitors to measure levels of air pollutants (airborne particles, endotoxin and hydrogen sulfide) outside the homes of eastern North Carolina residents who lived within 1.5 miles of one or more swine CAFOs. While the pollutants were being measured, community members reported twice daily about their mood and symptoms of illness. They also measured their lung function and blood pressure, and they reported the strength of the swine odor that they smelled inside and outside of their homes.

The study demonstrated that concentrations of CAFO pollutants recorded by the air monitors were correlated with neighbors' reports of swine odor.[5] This finding clearly shows that swine CAFO pollutants travel into neighboring communities where they are inhaled by residents. When swine odor was stronger, participants more often reported that their daily life activities were interrupted and that they felt stressed, gloomy, angry, and unable to concentrate. Higher levels of hydrogen sulfide and semi-volatile particles were associated with reports of feeling stressed or annoyed and nervous or anxious.[6] Swine CAFO neighbors report that they have lost some of the most treasured parts of their rural way of life, that family and community gatherings are no longer possible, that they can no longer use their private wells as a source for drinking water, and that their properties have depreciated in value.[7]

[3] S. Wing and S. Wolf, "Intensive Livestock Operations, Health, and Quality of Life among Eastern North Carolina Residents," *Environ Health Perspect* 108, no. 3 (2000).
[4] M. C. Mirabelli et al., "Asthma Symptoms among Adolescents Who Attend Public Schools That Are Located near Confined Swine Feeding Operations," *Pediatrics* 118, no. 1 (2006).
[5] S. Wing et al., "Air Pollution and Odor in Communities near Industrial Swine Operations," *Environ Health Perspect* 116, no. 10 (2008).
[6] R. A. Horton et al., "Malodor as a Trigger of Stress and Negative Mood in Neighbors of Industrial Hog Operations," *Am J Public Health* 99 Suppl 3(2009).
[7] M. Tajik et al., "Impact of Odor from Industrial Hog Operations on Daily Living Activities," *New Solut* 18, no. 2 (2008).

In the same study, higher levels of hydrogen sulfide were associated with reports of irritation of the eyes and nose, and with runny nose and difficulty breathing. Particle pollution was associated with reports of poor appetite, burning eyes, nasal irritation, wheezing, difficulty breathing, and decreases in lung function. Higher levels of endotoxin were associated with nausea, chest tightness, and sore throat.[8]

Swine CAFO odors and hydrogen sulfide concentrations in these communities were also associated with neighbors' blood pressure levels.[9] Elevated blood pressure is a well-recognized cause of stroke and heart disease, and the area of eastern North Carolina with the highest density of swine CAFOs is part of a region known as the "stroke belt." Residents of this region, who already suffer excess hypertension-related disease, should not be exposed to pollutants from swine CAFOs that further raise their blood pressures. Additionally, treatment of high blood pressure is a financial burden to patients as well as to private and public insurance systems.

Results from these studies represent average responses among study participants. Some people are more sensitive to environmental exposures than others. Overall, however, the studies provide solid evidence, consistent with findings from worker studies and studies in other regions, that air pollutants from swine CAFOs negatively impact health and quality of life.

In addition to studies of swine CAFO air pollution conducted in our state, a growing body of evidence from other states and countries shows that swine, poultry, and cattle CAFOs contaminate air and water and negatively impact the health and quality of life in neighboring communities.[10] Furthermore, hundreds of CAFOs in eastern North Carolina are located in areas subject to flooding that can transport liquid wastes into local communities,[11] and runoff can convey fecal pollution and associated pathogens to surface and ground water supplies and soils.[12] It is just a matter of time before another flood causes massive loss of liquid waste from the thousands of fecal waste lagoons that are in our state's flood plains.

Another concern is the widespread use of antibiotics in CAFOs. Research shows that the use of antibiotics in CAFOs has contributed to the emergence of antibiotic resistant bacteria that can cause dangerous, difficult-to-treat human infections.[13] Airborne bacteria, including antibiotic resistant strains, have been connected to CAFO air emissions,[14] and antibiotic resistant bacteria are associated with animal vectors

[8] L. Schinasi et al., "Air Pollution, Lung Function, and Physical Symptoms in Communities near Concentrated Swine Feeding Operations," *Epidemiology* 22, no. 2 (2011).

[9] S Wing et al., "Air pollution from industrial swine operations and blood pressure of neighboring residents. Environmental Health Perspectives. 121:92-96, (2013).

[10] K. Radon et al., "Environmental Exposure to Confined Animal Feeding Operations and Respiratory Health of Neighboring Residents," *Epidemiology* 18, no. 3 (2007); P. J. Villeneuve et al., "Intensive Hog Farming Operations and Self-Reported Health among Nearby Rural Residents in Ottawa, Canada," *BMC Public Health* 9(2009); P. S. Thorne, "Environmental Health Impacts of Concentrated Animal Feeding Operations: Anticipating Hazards--Searching for Solutions," *Environ Health Perspect* 115, no. 2 (2007).

[11] Wing et al., "The potential impact of flooding on confined animal feeding operations in eastern North Carolina," *Environ Health Perspect* 110, no. 4 (2002).

[12] Casteel et al., "Fecal contamination of agricultural soils before and after hurricane-associated flooding in North Carolina," *J Environ Sci Health A Tox Hazard Subst Environ Eng* 41, no. 2 (2006).

[13] E. K. Silbergeld et al., "One Reservoir: Redefining the Community Origins of Antimicrobial-Resistant Infections," *Med Clin North Am* 92, no. 6 (2008). E. K. Silbergeld, J. P. Graham, and L. B. Price, "Industrial Food Animal Production, Antimicrobial Resistance, and Human Health," *Annu. Rev. Public Health* 29, no. 15 (2008).

[14] J Schulz et al., "Longitudinal Study of the Contamination of Air and of Soil Surfaces in the Vicinity of Pig Barns by Livestock-Associated Methicillin-Resistant Staphylococcus aureus," *Appl Environ Microbiol* 78(16), 5666-5671 (2012). C. F.

near CAFOs, including flies,[15] rodents,[16] and migratory geese that land on North Carolina's swine waste lagoons.[17] A recent medical records study from Pennsylvania shows that people living near swine waste application sites have elevated hospitalization for infections with methicillin resistant *Staphylococcus aureus* (MRSA).[18] North Carolina swine and poultry CAFO workers carry strains of *Staphylococcus aureus* that are associated with livestock in general, and swine in particular,[19] that could be spread by liquid waste.

II. North Carolina's Swine CAFOs Overburden Low-Income Communities of Color

Research based on a review of state and federal records shows that North Carolina's swine CAFOs are disproportionately located in low-income communities of color.[20] Low-income people of color are more susceptible to CAFO pollution because of older housing, less access to air conditioning, increased exposures to other environmental and occupational hazards, higher prevalence of medical conditions that can be exacerbated by exposure to CAFO pollution, and inadequate access to medical services. The disproportionate burden of swine CAFOs in low-income communities of color represents an environmental injustice. Industrial swine production creates profits for out-of-state corporations and provides cheap pork for consumers at the expense of the health and dignity of eastern North Carolina residents who bear the brunt of the local pollution and health impacts. Additionally, the large numbers of CAFOs make these communities unattractive for economic development that would bring clean industries and good jobs.

The problem is not farming, rather it is the industrial production of animals in concentrations that produce massive quantities of waste and pollutants. These practices would never be tolerated in wealthy communities. In North Carolina, CAFO pollution is permitted by the Department of Environment and Natural Resources. The top ten swine-producing counties in the United States are all in eastern North Carolina; the health and environmental impacts of swine production in our state are not simply due to pollution from individual facilities, but result from the density of these operations. Sadly, our regulatory system has forsaken rural residents by allowing the destruction of their health and quality of life.

Green et al., "Bacterial Plume Emanating from the Air Surrounding Swine Confinement Operations," *J. Occup & Environ Hygiene*, 3:9-15, 2006. S. G. Gibbs, et al., "Isolation of Antibiotic-Resistant Bacteria from the Air Plume Downwind of a Swine Confined or Concentrated Animal Feeding Operation," *Environ Health Perspect*, 114:1032-1037, 2006.

[15] A. M. Rule et al., "Food animal transport: A potential source of community exposures to health hazards from industrial farming (CAFOs)," *J Infect & Pub Health*, 1:33-39, 2008.

[16] A. Van de Giessen, et al., "Occurrence of methicillin-resistant Staphylococcus aureus in rats living on pig farms," *Preventive Veterinary Medicine*, 91(2):270-273, 2009.

[17] D. Cole et al., "Free-livingCanada Geese and Antimicrobial Resistance," *Emerging Infectious Diseases*, 11:935-938, 2005.

[18] JA Casey et al., "High-Density Livestock Operations, Crop Field Application of Manure, and Risk of Community-Associated Methicillin-Resistant Staphylococcus aureus Infection in Pennsylvania," JAMA Internal Medicine, September 16, 2013.

[19] JL Rinsky et al., "Livestock-associated methicillin and multidrug resistant Staphylococcus aureus is present among industrial, not antibiotic-free livestock operation workers in North Carolina," PLoS ONE, 8(7): e67641, 2013. doi:10.1371/journal.pone.0067641.

[20] S. Wing, D. Cole, and G. Grant, "Environmental Injustice in North Carolina's Hog Industry," *Environ Health Perspect* 108, no. 3 (2000).

III. DENR Should Provide Records Needed to Document Environmental and Health Impacts

The ability of scientists to document health and environmental impacts of CAFO pollutants, and the ability of the public to become aware of the economic, social and health costs of the current system, is hampered by inadequate public availability of records. We request that DENR compile electronic records of information that permittees are required to collect and make them publicly available. These include:

- The waste level in each lagoon (freeboard levels) (III.2(a))
- Precipitation events, including rain levels (III.3)
- Soil fertility (III.4)
- The amount of nitrogen, phosphorus, zinc, and copper in the waste (III.5) as well as arsenic
- Dates of irrigation and land application events, quantities of liquid applied on each day, and other information about land application including hydraulic loading rates, nutrient loading rates, and cropping information, as well as information as to whether solids were removed and information about how those solids were disposed on site, or offsite (if applicable) (III.6)
- Waste transfers between structures on site that are not typically operated in a series (III.7)
- Monthly stocking records (these records are given to DENR, III.8)

In particular we request that DENR obtain each permittee's daily record of the quantities and locations of animal waste applied to land. We also request that DENR make public the boundaries of each field where swine waste is applied to land and detailed information about all pharmaceuticals and other additives in each permitee's swine feed. This information is important for advancing the scientific understanding of environmental and health impacts of land-application of manure and it is critical to the public's right-to-know about environmental pollutants and their costs to neighboring communities and the general public.

IV. Conclusion

The body of research documenting the damage that industrial swine production causes to human and environmental health continues to grow, and these burdens disproportionately impact communities of color and low income communities. More information about swine CAFOs should be publicly available to allow scientists and concerned citizens to monitor potential impacts. We urge you to modify CAFO permits to set a date in the near future after which the following will be prohibited: 1) the management of swine waste using lagoons and spray fields, 2) the non-therapeutic use of antibiotics in livestock production, and 3) the location of animal confinements and animal waste storage in flood plains. These changes are the minimum required to preserve the health and well-being of rural residents near swine operations.

Sincerely,
Steve Wing

Steve Wing, Ginger T. Guidry, Sarah Hatcher and Jessica Rinsky
UNC-CH School of Public Health

Exhibit 3

December 6, 2013

Via Email

Christine Lawson
NC Division of Water Resources
Animal Feeding Operations Unit
1636 Mail Service Center
Raleigh, North Carolina 27699-1636
christine.lawson@ncdenr.gov

Re: Renewal of North Carolina State General Permits to Control Animal Waste, AWG100000 (Swine Waste Management System General Permit), AWG200000 (Cattle Waste Management System General Permit), AWG300000 (Poultry Waste Management System)

Dear Ms. Lawson:

On behalf of the Catawba Riverkeeper Foundation, Cape Fear River Watch, Neuse Riverkeeper Foundation, North Carolina Environmental Justice Network, Pamlico-Tar River Foundation, Waterkeepers Carolina, Western North Carolina Alliance, Winyah Rivers Foundation, and Yadkin Riverkeeper, Inc., the undersigned would like to thank you for the opportunity to comment on the State General Permits for swine, cattle, and poultry waste management systems, AWG100000, AWG200000, and AWG300000, respectively.

Waste from animal facilities operating under these permits has long been a major concern for the citizens of North Carolina and particularly for the communities of color and low-income residents in the eastern part of the state that are routinely subject to pollution from these facilities. North Carolina permits more than two thousand five hundred animal facilities with the capacity to raise more than 10 million swine, cattle, and poultry in confinement under its general permit program.[1] These facilities generate a staggering amount of waste that pollutes North Carolina's surface water, groundwater and air, and injures neighboring communities. North Carolina's general permitting program for animal waste management systems should protect environment and these communities from these facilities. Yet, the

[1] *See* NCDENR, Aquifer Protection, Animal Feeding Operations: Permits, List of Permitted Animal Facilities, http://portal.ncdenr.org/web/wq/aps/afo/perm (last visited Dec. 6, 2013). This estimate does not include facilities with individual permits, those authorized under North Carolina's National Pollutant Discharge Elimination System general permit program, or the countless dry litter poultry facilities that the state deems permitted by regulation.

conditions in these permits are inadequate. On a daily basis, these facilities expose the citizens of North Carolina to harmful pollution.

The proposed drafts of the general permits will not improve these conditions. But for minor technical amendments, the program that the Department of Environment and Natural Resources ("DENR") and the Division of Water Resources ("DWR") is proposing is largely the same as its predecessors. As experience has shown, the general permitting program does not fully protect the state's air, water, or citizens from pollution from animal facilities. Nonetheless, DENR has proposed the same deficient program as the one that came before it. Just as troubling, the recent consolidation of state agencies with province over animal facilities, budget cuts, and the drastic reduction in the number of inspectors threaten to undermine DENR's ability to oversee the general permit program. The citizens of North Carolina need stronger permit conditions with greater accountability.

DENR and DWR have a responsibility to the public to do more to protect the environment and human health from pollution from industrial animal facilities than simply re-propose the same deficient general permits. These comments discuss areas where the general permits could be strengthened. However, no small change to the permitting program will protect North Carolina's environment and its citizens from the pollution generated at industrial animal facilities. In fact, federal civil rights law demands that DENR overhaul the permitting program. Under Title VI of the Civil Rights Act of 1964, DENR has an obligation to ensure that its programs or activities do not have an unjustified disparate impact on the basis of race, color, or national origin. Section II of these comments focuses on DENR's failure to live up to this mandate in permitting swine facilities given clear and longstanding evidence of their impact on communities of color. Research shows that the pollution from these facilities, which in North Carolina are primarily located in communities of color, is a hazard to human health and the environment. Thus, DENR's failure to require robust waste management technologies as a condition of the permit disproportionately impacts communities of color and the program must be redrawn to avoid this result.

In addition to revamping the general permit program for swine, cattle, and wet poultry facilities, DENR also should bring dry litter facilities under the general permitting program. These facilities impact water quality and neighboring communities, yet to date have been allowed to exist, essentially unregulated, with "permits" granted by operation of law. DENR must ensure that no animal facility is allowed to pollute North Carolina's water and air to the detriment of its citizens, including dry litter poultry facilities.

For all of these reasons, DENR must use this opportunity to take a hard look at how animal facilities are polluting the environment and affecting public health, and improve upon the way that waste is controlled at these operations. As currently proposed, the general permits are inadequate to protect North Carolina's communities and its resources.

I. THE PERMITTING PROGRAM'S FAILURE TO PROTECT THE ENVIRONMENT

With the proposed general permits, DENR has not come close to requiring Permittees to develop a "non-discharge system to prevent the discharge of pollutants to surface waters and wetlands."[2] Instead, as DENR is aware, industrial animal facilities operating under these permits are discharging significant nutrient and bacteria loads to watersheds across North Carolina.

For example, nonpoint source pollution from agriculture, including industrial animal operations, is a significant source of stream degradation in the Tar-Pamlico River Basin.[3] An estimated 10,000,000 chickens and 96 permitted swine facilities housing over 369,000 hogs located in the Tar-Pamlico Basin contribute to this degradation.[4]

The story is the same in the Neuse River Basin. There nutrient and bacteria discharges from intensive livestock facilities have caused widespread water quality impairments.[5] According the Final Neuse River Plan which was approved by the Environmental Management Commission in July of 2009:

> The land application of waste (*wet and dry*) is contributing to runoff of nutrients to the nutrient sensitive waters of the Neuse as well as from contaminated groundwater. Many of the facilities and land application fields are in an area of the coastal plain where the groundwater table is high which requires ditching or tile drain in order to allow for crop harvesting and waste application. *These are direct conveyances for the highly nutrient laden water to reach surface waters. These operations are having a significant negative impact on the Neuse River water quality*.[6]

Similarly, a section of the French Broad River that is widely used for recreation and fishing is impaired for bacteria pollution given the presence of animal facilities. Extensive sampling undertaken by the French Broad Riverkeeper from August 2012 through December 2013 show significant amounts of E. coli pollution entering the river system from the dairy facilities along this important stretch of river.

Independent researchers have confirmed that animal operations are discharging waste and bacteria into the state's waters. For example, a recent study reported that the Cape Fear and White Oak-New River Basins are severely impaired by nutrients and bacteria resulting

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[2] Condition I.1.
[3] DWR, DENR, Tar-Pamlico River Basinwide Water Quality Management Plan 7.1. (2010), *available at* http://portal.ncdenr.org/web/wq/ps/bpu/basin/tarpamlico/2010.
[4] *Id.* §§ 7.3-7.4.
[5] DWR, DENR, Final Neuse River Basinwide Water Quality Plan, Ch. 17 (2009), *available at* http://portal.ncdenr.org/web/wq/ps/bpu/basin/neuse/2009.
[6] *Id.* § 17.1.4 at 360 (emphasis added).

from industrial livestock facility discharges.[7] Additionally, unprecedented toxic algal blooms in 2009 and 2012 on the Cape Fear River have been at least partially attributed to nearby livestock production throughout the Cape Fear Basin.[8] Citizens working with researchers also have documented and shared evidence of contamination with DENR regarding on-going contamination in the Cape Fear River Basin due to the industrial hog operations.[9]

While the general permit program leaves substantial room for improvement, it clearly achieves greater protection of human health and the environment than a policy of total deregulation. As discussed below in Section IV, dry litter poultry facilities within the state are deemed permitted by regulation, a designation that leaves them with a permit in name only. Because they do not apply for coverage under the general permit, the state does not have a clear record of the number or location of these facilities. All the same, widespread pollution from dry litter facilities is well documented. In the Catawba River Basin, for example, DENR estimates that the shift from cattle facilities to poultry has affected water quality.[10] Many of the poultry facilities are located in the headwaters of the basin, leading to uncontrolled influxes of sediment into water bodies that are "usually very sensitive to the impacts of sedimentation," including High Quality Water, outstanding resource waters, and Trout Waters.[11] Nutrient pollution is a problem that increasingly plagues the Catawba River basin, and elevated bacterial levels continue to cause concern.[12]

Poultry pollution is also a problem in the Yadkin Pee Dee River Basin, where more than 12 million chickens are raised at industrial livestock operations in Wilkes County alone.[13] Discharges of bacteria and nutrients from these facilities are virtually unregulated, and are contributing to water quality degradation.[14] Most of poultry facilities are further concentrated in the High Rock Lake watershed, which is listed as an impaired waterbody under the Clean

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[7] *See* Michael A. Mallin and Lawrence B. Cahoon, UNC Wilmington, *Industrialized Animal Production - A Major Source of Nutrient and Microbial Pollution to Aquatic Ecosystems*, 24(5) Population and Environment (May 2003).

[8] *See* Justin D. Issacs et al., UNC Wilmington Center for Marine Science, *Microcystins and Two New Micropeptin Cyanopeptides Produced by Unprecedented* Microcystis aeruginosa B*looms in North Carolina's Cape Fear River*, 31 Harmful Algae 82 (2013).

[9] May 30, 2011 email communication between D. Baron, Rural Empowerment Association for Community Help and C. McNutt, Division of Water Quality, containing water quality sampling results in the Maple Branch watershed showing positive test results for fecal waste, high nitrate levels, E. coli, enterococci, and multidrug-resistant Staphylococcus.

[10] DWR, DENR, Catawba River Basinwide Water Quality Plan at 105.6 (NC DWQ 2010), *available at* http://portal.ncdenr.org/web/wq/ps/bpu/basin/catawba/2010.

[11] *Id.*

[12] For example, fifteen out of 32 ambient monitoring stations ("AMS") in the basin recorded fecal coliform bacteria levels above a geometric mean of 200 colonies/100 ml or 400 colonies/100 ml in 20% of AMS samples taken between 2004 and 2008. *Id.*

[13] Yadkin Riverkeeper, Pure Farms, Pure Water, https://yadkinriverkeeper.org/issues/pure-farms-pure-water?page=1.

[14] *Id.*

Water Act's Section 303(d) list. The High Rock Lake Watershed is considered the most threatened section of the Yadkin Pee Dee River Basin, primarily due to high levels of nutrients, chlorophyll and turbidity, and dissolved oxygen violations. [15]

The examples above highlight that the general permit program is not living up to the no-discharge promise. Thus, rather than simply reissuing the same permits offered since the program was enacted, DENR must use the renewal period as an opportunity to assess whether facilities are complying with the permits and come up with alternative measures to control the pollution that DENR itself knows is coming from these facilities.

II. NORTH CAROLINA'S PROPOSED GENERAL PERMIT FOR SWINE WASTE MANAGEMENT SYSTEMS SHOULD BE MODIFIED TO COME INTO COMPLIANCE WITH TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

North Carolina's proposed general permit for swine waste management system illegally overburdens communities of color. Under Title VI of the Civil Rights Act of 1964, "[n]o person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."[16] DENR receives federal financial assistance, and thus it is prohibited from operating in any way that disproportionately impacts individuals on the basis of race.[17] DENR's decision to reissue the general permit program for swine waste management systems, and DENR's imminent decisions to issue certificates of coverage allowing individual facilities to operate under the program, are actions that together disproportionately impact individuals on the basis of race. As currently proposed, North Carolina's general permit for swine waste management systems does not protect communities living near swine facilities.

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[15] DWR, NCDENR, Yadkin Pee-Dee River Basinwide Water Quality Plan (2008), *available at* http://portal.ncdenr.org/web/wq/ps/bpu/basin/yadkinpeedee/2008.

[16] 42 U.S.C. § 2000d.

[17] The term "program" means "all of the operations of . . . a department, agency, special purpose district, or other instrumentality of a State or of a local government . . . any part of which is extended Federal financial assistance." 42 U.S.C. § 2000d-4a(1)(A). DENR, a department of the State of North Carolina, receives federal financial assistance. For example, in September 2013, the United States Environmental Protection Agency awarded a $24 million grant to DENR under the Clean Water State Revolving Fund. *See* USASpending.gov, Prime Award Spending Data, http://usaspending.gov/advanced-search (enter "37000113" into field labeled "Federal Award Identifier *†"; then click "SEARCH") (last visited Dec. 4, 2013). Thus, all of DENR's operations constitute a program that cannot be carried out in a way that disproportionately impacts individuals on the basis of race. *See Ass'n of Mex.-Am. Educ. v. California*, 195 F.3d 465, 474-75 (9th Cir. 1999) ("[T]he definition of 'program or activity' provided by Congress means that if any part of a listed entity receives federal funds, the entire entity is covered by Title VI."), *rev'd in part on other grounds*, 231 F.3d 572 (9th Cir. 2000) (en banc); *see also* 40 C.F.R. §7.35(b) ("A recipient shall not use criteria or methods of administering its program or activity which have the effect of subjecting individuals to discrimination because of their race, color, national origin, or sex, or have the effect of defeating or substantially impairing accomplishment of the objectives of the program or activity with respect to individuals of a particular race, color, national origin, or sex.").

Indeed, despite the conditions in the general permit that seek to control pollution, facilities operating under the general permit pollute North Carolina's air and water and wreak havoc on the health and welfare of surrounding communities. Under the current system, swine facilities are disproportionately concentrated in communities of color. Thus, reissuing essentially the same permit program, and authorizing many of the same polluting facilities to operate under it, will adversely and disproportionately impact communities on the basis of race in violation of Title VI. DENR has no compelling justification for this disproportionate adverse impact. To remedy the Title VI violation, DENR must assess the racial and ethnic impact of the permitting program and adopt measures that protect communities from pollution from the swine facilities.

A. Industrial Swine Facilities Adversely Impact Neighboring Communities

Research has shown that industrial swine facilities expose neighboring communities to pollutants that make people sick and greatly reduce their quality of life.[18] The following sections describe a few of the many ways in which the two thousand plus swine facilities that operate under the general permit[19] injure nearby communities.

1. Surface and Ground Water Pollution from Swine Facilities Adversely Impacts Neighboring Communities

Swine facilities contribute to water contamination that threatens the environment and human health. Every year, confined farm animals in the United States generate approximately 500 million tons of manure, with farms that meet the legal definition of a concentrated animal feeding operation under federal law contributing over half of this pollution.[20] Most swine facilities in North Carolina funnel the animal waste from the confinement houses to open-air pits, called lagoons, where the waste is stored before it is applied to fields as fertilizer. Years of experience demonstrate that the lagoon and sprayfield system can pollute nearby waters and communities in many ways, one of the most dramatic of which is through lagoon breaches and spills. For example, after Hurricane Floyd, many of the lagoons in North Carolina swelled with

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[18] *See, e.g.*, Steve Wing & Susanne Wolf, *Intensive Livestock Operations, Health, and Quality of Life Among Eastern North Carolina Residents*, 108 Envtl. Health Perspectives 233, 233 (2000) ("Residents in the vicinity of the hog operation reported increased occurrences of headaches, runny nose, sore throat, excessive coughing, diarrhea, and burning eyes as compared to residents of the community with no intensive livestock operations."); Leah Schinasi et al., *Air Pollution, Lung Function, and Physical Symptoms in Communities Near Concentrated Animal Feeding Operations*, 22 Epidemiology 208, 208 (2011).

[19] These estimates are drawn from DENR's list of permitted animal operations. *See* NCDENR, Aquifer Protection, Animal Feeding Operations: Permits, List of Permitted Animal Facilities, http://portal.ncdenr.org/c/document_library/get_file?uuid=2daaeac0-8cc6-442c-b33b-86190ca5a7d5&groupId=38364 (downloadable spreadsheet).

[20] National Conference of State Legislatures, Concentrated Animal Feeding Operations, http://www.ncsl.org/research/agriculture-and-rural-development/concentrated-animal-feeding-operations.aspx (last visited Dec. 5, 2013) ("In 2003, the U.S. Environmental Protection Agency (EPA) projected that the nation's 257,000 animal feeding operations annually produced more than 500 million tons of manure. EPA estimated that CAFOs accounted for more than half of this amount.").

additional water and dumped waste into North Carolina's creeks, rivers, and streams.[21] Even without the aid of an intense storm, lagoons have overflowed, polluting nearby waters and communities.[22] Waste spilled from overflowing lagoons has been linked outbreaks from harmful pathogens, such as salmonella and E. coli,[23] has led to major freshwater fish kills, and has contributed to toxic algae outbreaks.[24]

Visible spills are not the only way that swine waste lagoons threaten the environment and communities.[25] Many of the lagoons in North Carolina were built in the 1990s, before it was well understood that lagoons must be lined with plastic and compacted clay to reduce the

[21] Steve Wing, et al., *The Potential Impact of Flooding on Confined Animal Feeding Operations in Eastern North Carolina*, 110 Envtl. Health Perspectives 387, 387 (2002), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240801/pdf/ehp0110-000387.pdf (describing how the 15-20 inches of rain dropped by Hurricane Floyd turned eastern North Carolina into a fecal flood zone). The flooding following Hurricane Floyd was not an isolated incident. *Id.* ("In 1996, 22 fecal waste pits were reported to have been ruptured or inundated following flooding from Hurricane Fran, and one major spill was reported following Hurricane Bonnie in 1998.").

[22] Ryke Longest, *Development in Environmental Law Applicable to Agricultural Business in North Carolina*, *in* Nat'l Envtl. Enforcement J., Nat'l Assoc. of Attorneys Gen'l *6 (2005), *available at* http://ssrn.com/abstract=2217601 (relating that in 1995, a swine lagoon at Oceanview Farms in Onslow County gushed out 25 million gallons of wastewater into local streams and ditches when one of its dike walls burst).

[23] Michael Greger & Gowri Koneswaran, *The Public Health Impacts of Concentrated Animal Feeding Operations on Local Communities*, 33 Farm Community Health 11, 13 (2010).

[24] Joann Burkholder et al., *Impacts of Waste from CAFOs on Water Quality*, 115 Envtl. Health Perspectives 308, 309 (2007), *available at* http://dx.doi.org/10.1289/ehp.8839.

[25] Recent drought conditions within the state have reduced the number of lagoon spills. However, this does not suggest that industry has cleaned up, but rather than conditions changed temporarily due to weather. In addition, with the drop in the number of inspectors across the state, lagoon failures and conditions leading to lagoon failures are less likely to be detected in a timely way as in the past.

potential for the stored waste to leach into groundwater.[26] These lagoons are grandfathered into the current system, and are allowed to operate with the same outdated technologies that threaten ground water and wells, unless and until DENR takes action to require the lagoons to do better.[27] Studies completed in eastern North Carolina have shown that swine facilities are contaminating shallow groundwater in part because of these lagoons.[28] Leakage from hog lagoons in North Carolina poses a real threat to human health; a study completed in 2000 found that "[a]lmost half of all hog CAFOs are located in block groups where > 85% of households have well water."[29] When the well water is contaminated, communities near these facilities are forced to choose between finding another water source (often at considerable expense), such as

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[26] According to one expert, "lagoons were expected to develop a seal at the liquid-soil interface that would impede seepage." R.L. Huffman, *Seepage Evaluation of Older Swine Lagoons in North Carolina*, 47(5) Am. Soc'y of Agric. Eng'rs 1507 (2004); *see also* Danny McCook, Discussion of Background Considerations in the Development of Appendix 10D to the Agricultural Waste Management Field Handbook 1 (2001), *available at* http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_024192.pdf ("Prior to about 1990, NRCS engineers commonly assumed that the accumulation of manure solids and the bacterial action resulting from a sludge interface would effectively reduce seepage . . . to an acceptable level."). These assumptions about the effectiveness of natural sealing turned out to be inaccurate or overstated. *See id.* ("However, research . . . demonstrated that . . . manure sealing . . . was not as complete as formerly believed."); *see also* Nat'l Res. Conservation Agency, Agricultural Waste Management System Component Design – Part 651: Agricultural Waste Management Field Handbook 10D-1 (rev. 1, 2008), *available at* ftp.wcc.nrcs.usda.gov/wntsc/AWM/handbook/ch10.pdf ("A rule of thumb supported by research is that manure sealing is not effective unless soils have at least 15 percent clay content for monogastric animal waste . . . ."). The General Assembly has, in recognition of this improved scientific awareness, generally prohibited the construction of new lagoons. *See* N.C. Gen. Stat. § 143-215.10*I*(b). Should such construction nevertheless be permitted, DENR would require that any new lagoon "be designed and constructed with synthetic liners to eliminate seepage." 15A NCAC § 2T.1307(b)(1)(A).

[27] A lagoon for which a permit was issued prior to 2007 "may continue to operate under . . . that permit, including any renewal [thereof]." *See* 2007 N.C. Sess. Laws 523 § 1(b). Grandfathering is also accomplished via DENR regulations. *See* 15A NCAC § 2T.1304(a)(1) (requiring animal waste management systems to meet "all applicable state statutes and rules *at the time of development or design*") (emphasis added). Where DENR is willing to acknowledge that these lagoons threaten water quality and the environment, it may require facilities to obtain an individual permit, which must remedy that threat. *Id.* § 2T.0111(h)(7) (indicating that DENR can require a facility whose lagoon "has been allowed to deteriorate or leak such that it poses an immediate threat to the environment" to obtain an individual permit).

[28] M.E. Anderson & M.D. Sobsey, *Detection and Occurrence of Antimicrobially Resistant* E. coli *in Groundwater on or near Swine Farms in Eastern North Carolina*, 54(3) Water Science & Tech. 211, 217 (2006) ("Overall, the results of this study demonstrated that antibiotic-resistant E. coli were present in groundwaters associated with commercial swine farms that have anaerobic lagoons and land application systems for swine waste management."); *see also* Wendee Nicole, *CAFOs and Environmental Justice: The Case of North Carolina*, 121(6) Envtl. Health Perspectives A182, A186 (2013) ("Even without spills, ammonia and nitrates may seep into groundwater, especially in the coastal plain where the water table is near the surface.").

[29] Steve Wing et al., *Environmental Injustice in North Carolina's Hog Industry*, 108(3) Envtl. Health Perspectives 225, 228 (2000) [Wing, *Environmental Injustice*].

signing up county water lines where available or purchasing bottled water, or exposing themselves to degraded water.

In addition to lagoon leaks and spills, the lagoon and sprayfield system threatens water quality and communities in other ways. For example, waste runs offs sprayfields when overapplied or applied on already saturated or frozen ground. Sprayers also apply waste directly into ditches that lead to surface waters. Finally, waste blows into surface waters or neighboring homes when it is sprayed on the fields.[30]

2. Air Pollution from Swine Facilities Adversely Affects Neighboring Communities

The confinement system authorized under the general permits contributes to air pollution that causes health problems among nearby populations and takes a toll on quality of life. The confinement houses at swine facilities are equipped with industrial fans that circulate air from the outside to cool the animals and bring in clean air. In so doing, the fans also push small particles and gasses that are injurious to human health and welfare into the air around the confinement houses. Decomposing waste in lagoons also contributes to air pollution. As the waste sits in the lagoon, it gives off methane and other malodorous or toxic gases, including hydrogen sulfide. In addition, the waste intended for the sprayfields can mist on nearby homes, cars, and laundry left out on the line to dry.[31]

One recent study of the impact of industrial swine operations on adults living in eastern North Carolina found that the odor and chemicals emitted from the operations, including hydrogen sulfide, leads to acute eye irritation, increased incidents of difficulty breathing, and increased wheezing.[32] The same study found that industrial hog facilities emit endotoxins, or toxins associated with bacteria, that contribute to increased incidence of sore throat, chest tightness, and nausea among the exposed population.[33] A separate study found that people living near a 6,000 head swine facility in North Carolina suffered elevated rates of respiratory and gastrointestinal problems, mucous membrane irritation, headaches, runny nose, sore throat,

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[30] For photograph of spraying into ditches, see Exhibits 1 and 2.
[31] *See* Nicole, *supra* note 28, at A183.
[32] Schinasi, *supra* note 18, at 208 (measuring pollutants levels and effect on 101 adults living near hog CAFOs in 16 eastern North Carolina communities).
[33] *Id.*

excessive coughing, diarrhea, and burning eyes as compared to residents in the control group that did not live near industrial livestock operations.[34]

Airborne pollution contributes to myriad health problems. Research also has shown that children and adults living and going to school near swine facilities have greater asthma rates than populations that are not exposed to swine facilities.[35] In addition, research has shown the risk of infant mortality linked to respiratory disease increases when pregnant women living near livestock production facilities. [36] Airborne pollution from industrial swine facilities also has been shown to reduce healthy immune function, thereby increasing a person's susceptibility to illness.[37]

The airborne pollutants and the accompanying odor not only harms health, it also has a huge effect on quality of life. People who live near swine facilities often are not able to open their windows, sit outside, or otherwise take full advantage of their property because of the intense and putrid odor associated with the facilities.[38] Studies also have shown that those

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[34] Wing & Wolf, *supra* note 18; *see also* Dana Cole et al., *Concentrated Swine Feeding Operations and Public Health: A Review of Occupational and Community Health Effects*, 108(8) Envtl. Health Perspectives 685 (2000) (reviewing literature on health effects associated with swine industrial agriculture); Susan Schiffman et al., *Symptomatic Effects of Exposure to Diluted Air Sampled from a Swine Confinement Atmosphere on Healthy Human Subjects*, 113(5) Envtl. Health Perspectives 567 (2005) (finding that those exposed to diluted swine air for two 1 hour sessions were more likely to report headaches, eye irritation, and nausea than the control group that was exposed to clean air).

[35] Maria C. Mirabelli et al., *Asthma Symptoms Among Adolescents Who Attend Public Schools That Are Located Near Confined Swine Feeding Operations*, 118 Pediatrics e66 (2006) (finding students aged 12 to 14 who attended North Carolina public schools within 3 miles of industrial swine facilities reported increased asthma-related symptoms, more doctor-diagnosed asthma, and more asthma-related medical visits compared to peers at other schools); James Merchant et al., *Asthma and Farm Exposures in a Cohort of Rural Iowa Children*, 113 Envtl. Health Perspectives 350 (2005) (finding children living on swine farms, including large facilities with more than 500 head, experienced increased rates of asthma compared to non-exposed children; results more pronounced where swine facilities added antibiotics to feed); Katja Radon et al., *Environmental Exposure to Confined Animal Feeding Operations and Respiratory Health of Neighboring Residents*, 18 Epidemiology 300 (2007) (surveying nearly 7,000 residents of four German towns with high confined livestock operation densities and concluding that such operations "may contribute to the burden of respiratory disease among their neighbors").

[36] Stacy Sneeringer, *Does Animal Feeding Operation Pollution Hurt Public Health? A National Longitudinal Study of Health Externalities Identified by Geographic Shifts in Livestock Production*, 91 Am. J. of Agric. Econ. 124, 130 (2009).

[37] Rachel Avery et al., *Odor from Industrial Hog Farming Operations and Mucosal Immune Function in Neighbors*, 59(2) Archives of Envtl. Health 101 (2004) (finding that swine odor was associated with reduced mucosal immune function among 15 adults living near industrial swine operations in North Carolina).

[38] *See, e.g.*, Wing & Wolf, *supra* note 18; *see also* Steve Wing et al., *Air Pollution and Odor in Communities Near Industrial Swine Operations*, 116(10) Envtl. Health Perspectives 1362 (2008) (study participants living within 1.5 miles of swine factory farm reported altering or ceasing normal daily activities when hog odor was strongest) [Wing, *Air Pollution and Odor*].

living near swine facilities report more tension, more depression, more anger, less vigor, more fatigue, and more confusion that control subjects who are not exposed to industrial animal production.[39]

3. Swine Facilities Can Spread Antibiotic-Resistant Bacteria, Which Threatens Human Health

Swine facilities also risk spreading antibiotic-resistant bacteria, which also threatens human health. Many swine facilities use antibiotics not simply to treat disease, but instead to promote growth and to preemptively ward off the threat of disease.[40] A growing body of research has documented the emergence of antibiotic-resistant bacteria linked to the overuse of antibiotics in livestock production. For example, studies across the world, including here in the United States, have found a specific strain of methicillin-resistant Staphylococcus aureus ("MRSA") in both swine and people who work in the swine industry.[41] These antibiotic-resistant bacteria can be transferred from farm animals to humans via airborne particle emitted

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[39] *See, e.g.*, Susan Schiffman et al., *The Effect of Environmental Odors Emanating from Commercial Swine Operations on the Mood of Nearby Residents*. 37 Brain Research Bull. 369 (1995); Wing, *Air Pollution and Odor*, *supra* note 38 (finding that when hog odor was the strongest, study participants more frequently reported feeling stressed, gloomy, angry and unable to concentrate).

[40] James MacDonald & William McBride, USDA, *The Transformation of U.S. Livestock Agriculture: Scale, Efficiency, and Risks* 32-35 (2009), *available at* http://www.ers.usda.gov/ersDownloadHandler.ashx?file=/media/184977/eib43.pdf (downloadable PDF).

[41] Tara C. Smith et al., *Methicillin-Resistant* Staphylococcus auereus *(MRSA) Strain ST398 Is Present in Midwestern U.S. Swine and Swine Workers*, 4 PLoS One e4258 (2009); Tara C. Smith et al., *Methicillin-Resistant* Staphylococcus aureus *in Pigs and Farm Workers on Conventional and Antibiotic-Free Swine Farms in the USA*, 8 PLoS One e63704 (2013); Jessica L. Rinsky et al., *Livestock-Associated Methicillin and Multidrug Resistant* Staphylococcus aureus *Is Present Among Industrial, Not Antibiotic-Free Livestock Operation Workers in North Carolina*, 8 PLoS One e67641 (2013); Xander W. Huijsdens et al., *Community-Acquired MRSA and Pig-Farming*, 5 Annals of Clinical Microbiology & Antimicrobials 26 (2006) (Netherlands); Ingrid V.F. Van den Broek et al., *Methicillin-Resistant* Staphylococcus aureus *in People Living and Working in Pig Farms*, 137(5) J. Epidem. & Infection 700 (2009) (Netherlands); Oliver Denis et al., *Methicillin-Resistant* Staphylococcus aureus *ST398 in Swine Farm Personnel, Belgium*, 15(7) Emerging Infectious Diseases 1098 (2009) (Belgium); Khanna et al., *Methicillin Resistant* Staphylococcus aureus *Colonization in Pigs and Pig Farmers*, 128 J. Veteriary Microbiology 298 (2008) (Canada).

from the confinement houses.[42] Antibiotic-resistant bacteria associated with industrial livestock production also can be transmitted through water. For example, a recent water quality study found that samples taken near industrial animal facilities were more likely to contain multi-drug resistant bacteria than water sampled elsewhere.[43]

A recent report by the Center for Disease Control highlights that the growing number of antibiotic-resistant bacteria is a significant to human health.[44] According to the report, each year more at last 2 million people in the United States acquire a serious infection that is resistant to antibiotics, and at least 23,000 people die each year as a result of those infections.[45] Among those infections, "MRSA infections can be very serious and the number of infections is among the highest of all antibiotic-resistant threats."[46] The report estimates that MRSA infections are declining, but cautions that if infection rates increase, or if the strains become resistant to other antibiotics, then MRSA will become an increasingly urgent threat.[47]

4. Proximity to Swine Facilities Depresses Property Values

Finally, in addition to the health and welfare impacts discussed above, living near a swine facility has negative economic effects. Studies across the country, including in North Carolina, have demonstrated a statistically significant relationship between declining property

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[42] Amy Chapin et al., *Airborne Multidrug-Resistant Bacteria Isolated from a Concentrated Swine Feeding Operation*, 113 Envtl. Health Perspectives 137, 137 (2005) (finding multidrug-resistant *Enterococcus*, coagulase-negative staphylococci, and viridans group streptococci in the air of an industrial swine operation at levels dangerous to human health); Shawn Gibbs et al., *Airborne Antibiotic Resistant and Nonresistant Bacteria and Fungi Recovered from Two Swine Herd Confined Animal Feeding Operations*, 1 J. of Occupational and Envtl. Hygiene 699 (2004) (finding multidrug-resistant bacteria inside and downwind of industrial swine operations at levels previously determined to pose a human health hazard); Julia Barrett, *Airborne Bacteria in CAFOs: Transfer of Resistance from Animals to Humans*, 113 Envtl. Health Perspectives, A116, A116-17 (2005) (reviewing literature on cross-species transfer of antibiotic-resistant bacteria); Jochen Schulz et al., Longitudinal Study of the Contamination of Air and of Soil Surfaces in the Vicinity of Pig Barns by Livestock-Associated Methicillin-Resistant Staphylococcus aureus, 78 Applied Envtl. Microbiol. 5666 (2012) (detecting MRSA 300 feet from a barn where the animals, the air, the workers' plastic boots tested positive for MRSA).

[43] Bridgett West et al., *Antibiotic Resistance, Gene Transfer, and Water Quality Patterns Observed in Waterways Near CAFO Farms and Wastewater Treatment Facilities*, 217 Water Air Soil Pollution 473 (2011).

[44] Centers for Disease Control, U.S. Dep't of Health and Human Servs., Antibiotic Resistance Threats in the United States, 2013 (2013), *available at* http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf.

[45] *Id.* at 6.

[46] *Id.* at 20.

[47] *Id.*

values and proximity to a swine facility.[48] The research suggests that property values will decline with increasing proximity to a swine facility, and with the increasing number of swine at the facility.[49]

As this body of research shows, swine facilities adversely impact adjacent communities. People who live near swine facilities are exposed to toxic water and air pollution that not only make enjoying time spent at home more difficult, but also threatens mental and physical health and depresses the value of nearby homes.

B. African American Communities Disproportionately Bear the Impact of Swine Facilities

In North Carolina, a disproportionate number of African-Americans as compared to the general population are adversely affected by swine facilities. Under the current permitting system, swine facilities are concentrated in communities of color, and the number and location of swine facilities is not expected to change significantly with this new permitting cycle.

The maps below show the swine facilities permitted under the current program as black dots overlaying a map of the state. The different colors on the map show the population densities, per United State Census data, the first reflecting percentage non-white and the second the percentage African American in the population. The first map shows that most of the swine facilities in the state are concentrated in counties in which the non-white populate is greater than 20 percent, and more often than not, is greater than 40 percent.

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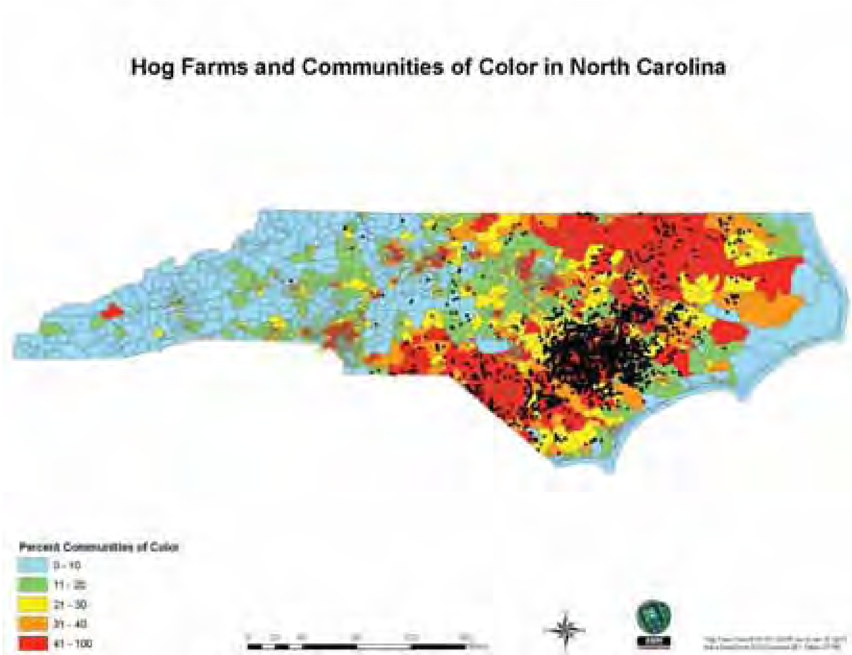
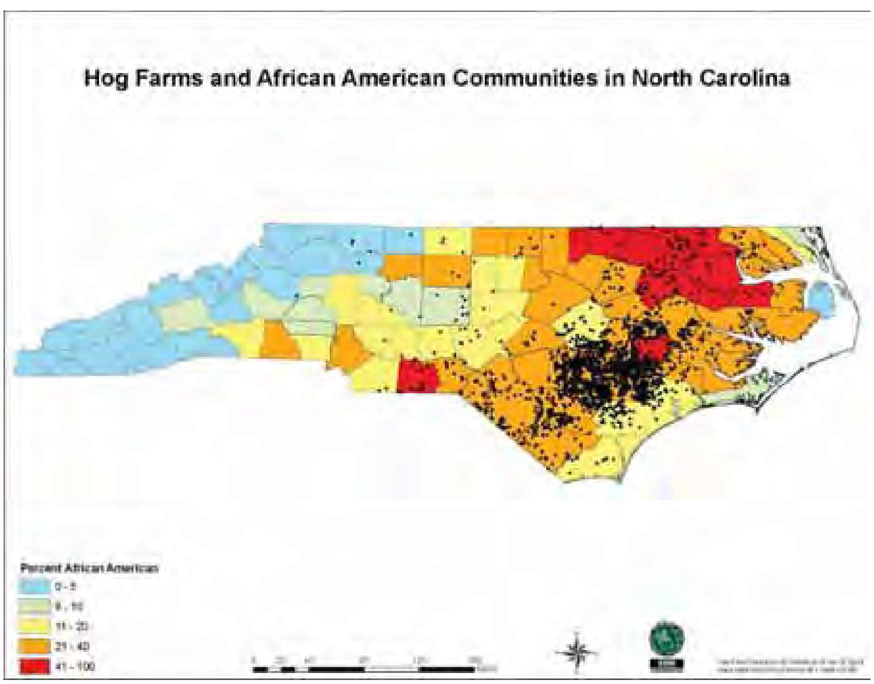
[48] Raymond Palmquist et al., *Hog Operations, Environmental Effects, and Residential Property Values*, 73(1) Land Econ. 114 (1997) (studying the relationship between swine factory farms on property values in nine counties in southeastern North Carolina and finding that the effect on price depended on the distance from the factory farm and the number of confined animals in the area); Katherine Milla et al., *Evaluating the Effect of Proximity to Hog Farms on Residential Property Values: A GIS Hedonic Model Approach*, 17 URISA J. 1, 27 (2005) (finding that values in Craven County, North Carolina decreased with increasing number of confined hogs and as the distance between the homes and the factory farms decreased); Jungik Kim & Peter Goldsmith, *A Spatial Hedonic Approach to Assess the Impact of Swine Production on Residential Property Values*, 42(4) Env. & Resource Econ. 509 (2009) (estimating decline in property value on a per hog basis in Craven County, North Carolina); Joseph Herriges et al., *Living with Hogs in Iowa: The Impact of Livestock Facilities on Rural Residential Property Values*, 81(44) Land Econ. 530 (2005).

[49] Palmquist et al., *supra* note 48; Milla et al., *supra* note 48.



The second map shows that swine facilities are overwhelmingly located in communities where the African American population is greater than 20 percent.



Thus, if largely the same swine facilities are given certificates of coverage to operate under the proposed general permit, communities of color will continue to disproportionately bear the impact of the swine factory farms.

The swine industry's disproportionate impact on the basis of race has long been known and documented. It is time for the state to pay attention to the problem and bring the permitting program into compliance with the law. For example, a study examining the relationship between race and spatial concentration of swine waste (and thus swine facilities) in eastern North Carolina between 1982 and 1997 found evidence that "minority communities and localities lacking the political capacity to resist are shouldering the bulk of the adverse economic, social, and environmental impacts of the pork industry restructuring."[50] The study also concluded that in eastern North Carolina, where at the time 95% of North Carolina's swine waste was produced, there was a "strong direct relationship between poverty and concentrated swine waste."[51] A later study found that there were nine times more hog factory farms in areas where there was more poverty and high percentages of non-white people.[52] Research on school distribution in North Carolina also has shown that swine facilities overburden communities of color. The research has found that schools in lower income areas with a larger non-white population are more likely to be sited near an industrial livestock operation than other schools in the state.[53] This research supports the above analysis, further demonstrating that the system of permitting swine facilities in North Carolina disproportionately impacts communities of color.

Strikingly, then, although swine facilities have historically had a disproportionately impact on the basis of race, there is no evidence that DENR took steps to analyze the disparity its permitting program creates or attempted to address the disparity in any way.

C. Less Discriminatory Alternatives to the Proposed General Permit

Rather than perpetuating the current system for permitting swine animal waste management systems, which unduly overburdens communities of color, DENR must consider alternative ways of managing waste at these facilities that would have a less discriminatory impact. One way to lessen the impact that swine facilities have on surrounding communities is to adopt permit conditions that require facilities to improve their waste management systems.

Abandoning the lagoon and sprayfield model would go a long way to prevent swine facilities from polluting the water and air, and injuring nearby communities. As is described

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[50] Bob Edwards & Anthony E. Ladd, *Race, Class, Political Capacity and the Spatial Distribution of Swine Waste in North Carolina*, 1982-1997, 9 N.C. Geographer 51, 51 (2001).
[51] *Id.*
[52] Wing, *Environmental Injustice supra* note 29, at 225.
[53] Maria Mirabelli et al., *Race, Poverty, and Potential Exposure of Middle-School Students to Air Emissions from Confined Swine Feeding Operations*, 114 Envtl. Health Perspectives 591 (2006) (finding schools in North Carolina with white student population less than 63% and subsidized-lunch eligible population greater than 47% were more likely to be located within 3 miles of a factory farm than were schools with high-white or high-socioeconomic status populations); Paul Stretesky et al., *Environmental Inequity: An Analysis of Large-Scale Hog Operations in 17 States, 1982-1997*, 68 Rural Sociology 231 (2003) (finding that between 1982 and 1997, large-scale hog operations in North Carolina were more likely to be sited in areas that had a disproportionate number of black residents).

above, the lagoons are prone to overflowing into surface waters and leaking pollutants directly into groundwater and contaminating wells. The lagoons themselves also emit gasses as the waste decomposes. Spraying also contributes water quality issues, as waste that is overapplied can run off into surface water, leak into ground water, and blow into neighboring properties. Short of moving away from the lagoon and sprayfield system, facilities could take other measures to improve upon the lagoons. For example, facilities could retrofit existing lagoons to recover valuable byproducts that can be used as fertilizer, while treating the remaining effluent to generate liquid that can be used to fertilize fields.[54] Facilities also could install anaerobic digesters that recover methane from the lagoon to generate biogas that can be used to generate electricity and heat, again along with measures to address remaining waste problems.[55] DENR should consider these options and others in an effort to improve the system that illegally impacts communities of color.

DENR should also consider requiring the facilities to install controls on the confinement houses that filter the air before pushing it up and out. These controls should filter the harmful substances, including fine particles, dust, and gasses that take a toll on human health. Such "end of pipe" controls could limit the impact these facilities have on neighboring communities. DENR should exercise its authority to reduce harmful air pollution as part of its program to control animal waste. Air pollution is a large byproduct of these animal systems that should be addressed under a comprehensive program to address animal waste. In addition, DENR has the authority to control pollutants that are emitted first into the air that later are washed into waters under laws designed to protect water quality.[56] Thus, to the extent that the program is implemented under laws designed to protect water quality, DENR still has a responsibility to control pollution that is first emitted in the air and affects water quality. For all of these reasons, DENR should require permitted facilities to meet standards to reduce airborne pollutants.

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[54] A recent article on sustainable swine production discusses alternative "end-of-pipe" technologies that improve upon the current lagoon and sprayfield system, including lagoon retrofits. *See* Michelle B. Nowlin, *Sustainable Production of Swine: Putting Lipstick on a Pig?*, 37 Vt. L. Rev. 1079, 1116-1127 (2013). One potential is the "Super Soils" technology, which uses a wastewater treatment system to separate the solids and nutrients to create fertilizer and other value-added by products and treated the water for irrigation and to clean the barns. *Id.* at 1121-23. The Crystal Peak Fertilizer process similarly concentrates and digests the solids in the waste, dries the solids using harvested gasses, and uses the cleaned water for irrigation. *Id.* at 1127.

[55] *Id.* at 1123-25 (describing a waste to energy project that uses an anaerobic digester that collects gases to feed a microturbine that powers the facility); *id.* at 1128 (describing a project that used a metal scraper, as opposed to a flush system, to move the waste from the facility to an anaerobic digester that converted the waste to energy). Methane recapture and similar programs are insufficient on their own and would need to be accompanied by other provisions to prevent harm to the environment and health. Moreover, these types of measures threaten to further concentrate swine facilities and entrench the current system of raising large numbers of animals in confinement.

[56] *Rose Acre Farms, Inc. v. NC Dep't of Envt. & Natural Resources*, 12-CVS-10, slip op. at 8-9 (Hyde County Sup. Ct. Jan. 7, 2013).

Finally, DENR should modify permit conditions as described in the following section to mitigate the impact of its permitting program.

III. AREAS WHERE DENR SHOULD STRENGTHEN THE GENERAL PERMITS TO PROTECT THE ENVIRONMENT AND HUMAN HEALTH

Many of the conditions in the animal waste management general permit for swine, poultry, and cattle either fail to protect the environment and human health or are not in keeping with best scientific practices. The following sections provide specific comments on conditions in the proposed general permits that should be improved.

A. Condition I.1

DENR must ensure that animal waste management systems do not discharge pollution into waters of the state. The current conditions, however, do not protect against discharges.

For example, the permit currently requires facilities to be "designed, constructed, operated, and maintained to contain all waste plus the runoff from a 25-year, 24-hour rainfall event for the location of the facility." Yet DENR continues to tie its standard for 25-year, 24-hour rainfall events to antiquated rainfall information dated to the 1960s. The permits provide:

> **25-year, 24-hour rainfall or storm event** means the maximum 24-hour precipitation event with a probable recurrence interval of once in 25 years, *as defined by the National Weather Service in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments*, or equivalent regional or state rainfall probability information developed therefrom.[57]

This definition fails to provide clear guidance reflecting the fact that the National Oceanic and Atmospheric Administration ("NOAA") has updated its rainfall tables. By continuing to rely primarily on the 1961 authority, without citing any of the subsequent amendments, the permit fails to mandate that facilities must be prepared for more severe weather events, which are now more frequent.[58] Given that extreme weather events are no longer rare one offs, the old standard is not as protective against discharge as it may have been in the past. To ensure that Permittees maintain adequate waste storage conditions, and do not unduly discharge to waters of the State, the general permit should ensure that the standard used will reflect current science so that lagoons can store precipitation, while maintaining a buffer to account for the risk of a rare, but powerful storm.

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[57] Condition VII, definition of 25-year, 24-hour rainfall or storm event, emphasis added.

[58] *See, e.g.*, 2 NOAA Atlas 14, Precipitation-Frequency Atlas of the United States: Delaware, District of Columbia, Illinois, Indiana, Kentucky, Maryland, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia (2006), *available at* http://www.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume2.pdf.

Similarly, DENR should clarify the last paragraph of Condition I.1 which appears to allow "any discharge [from] or application of waste to a ditch that drains to surface waters or wetlands" where the discharge is controlled by best management practices ("BMPs") designed in accordance with NRCS standards and the BMPs were implemented as designed to prevent a discharge to surface waters or wetlands. If this is the intent of this paragraph, it should be removed. We are unaware of any NRCS standard that prescribes best practices that would allow a Permittee to apply waste to a ditch that drains to surface waters or wetlands, or discharge waste from a ditch that drains to surface waters. Best practices prohibit applying waste to or discharging from ditches that drain to surface waters, and those best practices should be incorporated into this permit. Thus, DENR should simply prohibit any discharge from or application of waste to a ditch that drains to surface waters or wetlands.

If, however, in the last paragraph of Condition I.1, DENR intended to further limit when a Permittee might avail itself of the safe harbor allowing discharges in the event of storm more severe than a 25-year, 24-hour storm, DENR should clarify that intent. The last sentence of Condition I.1 states that "[n]othing in this exception shall excuse a discharge to surface waters or wetlands except as may result because of rainfall from a storm event more severe than the 25-year, 24-hour storm." If DENR added that last sentence to convey that the only authorized discharges from ditches that drain to surface waters and wetlands are those that ***BOTH*** are prompted by a storm more severe than the 25-year, 24-hour rainfall event ***AND*** meet the additional conditions in the paragraph, then DENR should reverse the order of the last paragraph, along the following lines:

> All discharges to surface waters or wetlands, including discharges resulting from application of waste to a ditch that drains to surface waters or wetlands, are prohibited unless they result from rainfall from a storm event more severe than the 25-year, 24-hour storm. Furthermore, discharges resulting from application of waste to a ditch that drains to surface waters or wetlands must meet the following additional conditions: (a) discharges from the ditches are controlled by best management practices (BMPs) designed in accordance with NRCS standards; (b) the BMPs have been submitted to and approved by the Division of Water Resources (Division); (c) the BMPs were implemented as designed to prevent a discharge to surface waters or wetlands; (d) the waste was removed immediately from the ditch upon discovery; and (e) the event was documented and reported in accordance with Condition III.13.

B. Condition I.3

Proposed Condition I.3 requires the Permittee to "assess and record, on an ongoing basis, the effectiveness of the implementation of the [Certified Animal Waste Management Plan]." DENR should require these assessments to be submitted to DWR quarterly, or at least with the annual certification report required under Condition III.14 (as revised per these comments). DENR should also make these assessments available to the public.[59]

Under the proposed version of Condition I.3, Permittees need not submit an amendment to their Certified Animal Waste Management Plan ("CAWMP") to the Division of Water Resources Regional Office "unless specifically requested by the Division." However, DENR should require Permittees to submit all amendments to the CAWMP to the DWR for approval. The CAMWP is one of the primary tools required under the general permit to ensure that the permitted facilities do not contribute to surface or ground water pollution. Putting aside the question whether the plans achieve their goal, DWR and DENR should be made aware of any and all changes to the CAWMP.

Indeed, the permit defines amendments to include changes to the CAWMP that could affect whether it protects water quality. For example, under the definition of amendment, a Permittee would not need to submit "a change in crops and/or cropping pattern that utilizes 25% or less of the N generated."[60] DWR and DENR have an obligation to ensure that amid changes, the CAMWP is designed to prevent pollution of surface and ground water, and that the facility is properly covered under the general permit. DWR and DENR cannot ensure proper waste management unless they understand all changes to the plan, including changes in crops or cropping patterns at the land application sites. As currently conceived, the Permittee and the Permittee alone is able to determine whether, with the changes to its crops, it will still be able to apply waste at agronomic rates. DWR and DENR must oversee this process.

C. Condition I.5

Under proposed Condition I.5, DWR may require facilities located in watersheds sensitive to nutrient enrichment to conduct an evaluation of the facility and its CAWMP to determine whether the facility is able to comply with the NRCS nutrient management standard for phosphorus. This condition, as proposed, does not sufficiently protect water quality. DWR should require all facilities in all watersheds, not just sensitive watersheds, to submit to a DWR-completed facility-wide evaluation at least every three years to ensure that the facility is able to comply with the NRCS nutrient management standards for phosphorus. In addition, the general permit should prohibit all facilities, not just those in watersheds sensitive to nutrient enrichment, from applying waste on fields with a "HIGH" phosphorus-loss assessment rating at rates that exceed the established crop removal rate for phosphorus. DENR also must require the agronomic application of waste in all instances.

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[59] Section III.X, *infra.*

[60] *See* First Bullet under Definition of Amendment.

D. Condition I.6

Under proposed Condition 1.6, "[i]f prior approval is received from the Director of the Division (Director), facilities that have been issued a COC to operate under this General Permit may add treatment units for the purpose of removing pollutants before the waste is discharged into the lagoons/storage ponds." The general permit does not, but should, define the term "treatment units." DENR should also clarify that nothing in this Condition shall allow Permittees to circumvent the state law barring authorities from "issu[ing] or modify[ing] a permit to authorize the construction, operation, or expansion of an animal waste management system that serves a swine farm that employs an anaerobic lagoon as the primary method of treatment."[61]

E. Condition I.7

Under proposed Condition I.7, "[i]f prior approval is received from the Director, facilities that have been issued a COC to operate under this General Permit may add innovative treatment processes to the systems on a pilot basis in order to determine if the innovative treatment process will improve how the waste is treated and/or managed." The general permit does not, but should, define the term "innovative treatment process." If DENR intends to refer to the sorts of technologies first described in Session Law 1997-458, and clarified in Session Law 1998-188 – namely, those which "do[] not employ an anaerobic lagoon," "do[] not employ land application of waste," and are "designed to be the subject of a research project" – it should so state.[62] DENR should also clarify that nothing in this Condition shall allow Permittees to circumvent the state law barring authorities from "issu[ing] or modify[ing] a permit to authorize the construction, operation, or expansion of an animal waste management system that serves a swine farm that employs an anaerobic lagoon as the primary method of treatment."[63]

F. Condition I.8

DENR has proposed to renew Condition I.8 without change. As currently proposed, DENR would require a 100 foot setback from wells, other than monitoring wells, when applying animal waste. A 100-foot setback is the national minimum setback from wells recommended by EPA.[64] As such, it does not take into account state-specific conditions that require further setbacks to protect the integrity of well water.

The number of animal operations in North Carolina along with its unique soil warrants a greater minimum setback distance than the 100 feet currently proposed. North Carolina is the

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[61] N.C. Gen. Stat. § 143-215.10*I*.
[62] 1997 S.L. 458 § 1.1(b)(7) (H.B. 515) (as modified by 1998 S.L. 188 sec. 2 (H.B. 1480)).
[63] N.C. Gen. Stat. § 143-215.10*I*.
[64] Office of Wastewater Mgmt., U.S. EPA, Producers' Compliance Guide for CAFOs: Revised Clean Water Act Regulations for Concentrated Animal Feeding Operations (CAFOs) 33 (2003), *available at* http://www.epa.gov/rfa/documents/Compliance-CAFOs.pdf.

"second highest swine producing state in the Nation."[65] Most of the swine facilities are located in the east portion of the state, "a region that is sensitive because of low-lying flood plains and high water tables."[66] In addition, North Carolina has many different types of soil—from sand and loam to clay—that differ widely in their capacity to absorb animal waste as it is applied to the land.[67] One study of North Carolina swine waste sprayfields showed that only 62% of nitrogen in applied waste was absorbed by onsite soils.[68] Of the remaining 38%, 22% was lost to "unintended offsite transport" and 16% remained unaccounted for in onsite soils.[69] This research suggests that a significant amount of nitrogen that is applied to sprayfields in North Carolina could be transported through the porous land to nearby ground water resources, like wells. The general permit should take into account this research and increase the setbacks from wells.

North Carolina would not be alone in requiring increased setbacks. Other states with comparably high densities of industrial animal operations have rejected the 100-foot minimum in favor of more protective setback distances. Iowa, for example, enforces setback distances of 200 feet from any drinking water well, and 800 feet from high quality water resources, including those with exceptional recreational and ecological importance, heightened public usefulness due to outstanding physical qualities, or unique scenic value.[70] Georgia, which shares a partial border with North Carolina, has a minimum of 250 feet from private wells.[71] The minimum setback distance in Illinois is 150 feet.[72]

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[65] N.C. Water Sci. Center, U.S. Geological Survey, Surface-Water Quality and Swine CAFOs, http://nc.water.usgs.gov/projects/cafo/summary.html (last modified Mar. 13, 2013).

[66] Wing, *Environmental Injustice supra* note 29, at 225 ("In the past, hog production was dispersed throughout the state, but it has become consolidated in the coastal plain region, which concentrates waste and the potential for environmental damage in a region that is sensitive because of low-lying flood plains and high water tables.").

[67] As one former state official noted: "Eastern North Carolina's situation is complicated by a crazy-quilt of soil types where layers of sand, loam and clay begin and end abruptly." Joby Warrick & Pat Stith, *New Studies Show That Lagoons Are Leaking*, News & Observer, Feb. 19, 1995, http://www.pulitzer.org/archives/5893.

[68] Jeffrey T. DeBerardinis, Nitrogen Mass Balance for Spray Fields Fertilized with Liquid Swine Waste 67 (2006) (unpublished M.S. thesis, University of North Carolina at Chapel Hill), *available at* http://dc.lib.unc.edu/cdm/singleitem/collection/etd/id/262.

[69] *Id.*

[70] Iowa Dep't of Natural Res., Separation Distances for Land Application of Manure from Open Feedlots & Confinement Feeding Operations, including SAFOs, 1 tbl. 2 (2003), *available at* http://www.iowadnr.gov/portals/idnr/uploads/afo/fs_sepdstb4.pdf. For a description of Iowa's high quality protected resources, see Iowa Dep't of Natural Res., High Quality Water Resources: A List for Manure Applicators and Producers Who Need a Construction Permit (2003), *available at* http://www.iowadnr.gov/Portals/idnr/uploads/afo/fs_hqwr2.pdf.

[71] Envtl. Prot. Div., Ga. Dep't of Natural Res., Guidelines for Land Application of Sewage Sludge (Biosolids) at Agronomic Rates (2006), *available at* http://www.gaepd.org/Files_PDF/techguide/wpb/smplasguidelinerev_June2006.pdf.

[72] 35 Ill. Adm. Code 560.203.

Another common practice is for state authorities to modify setback distances for public or community wells, i.e. those serving several households. For example, Wisconsin generally employs the same general 100-foot setback from wells, yet requires a 1,000-foot setback from community wells.[73] Georgia requires a 500-foot setback for public or community wells, as compared with the 250-foot setback from private wells.[74] Another neighboring state, South Carolina requires at least a 200 foot setback from both public and private drinking wells.[75]

North Carolina should follow these states' lead and require greater setbacks across the board. At a minimum, North Carolina should require greater setbacks for community wells and pristine waters. For the foregoing reasons, we suggest that DWQ amend Condition I.8 to:

- Increase the minimum setback for private wells to at least 500 feet.
- Impose a separate setback applicable to public or community wells of at least 1000 feet.
- Impose a separate setback to protect waters that have high recreational use as well as designated high quality waters.[76]

G. Condition II.7

Proposed Condition II.7 allows Permittees to wait for up to 2 days before tilling manure or sludges that have been applied to bare soil, or before an earlier predicted rainfall. DENR should revise this condition to require manure and sludges to be incorporated into the soil within twelve hours of application to bare soil to better protect against runoff or odor. Studies have concluded that "solid livestock manure [should] be incorporated into the soil within 12 hours of broadcasting in order to maximize the nutritional benefits to the soil and minimize odors and possible environmental effects the manure may have."[77] By incorporating the waste

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[73] Wis. Adm. Code NR § 243.14(2).9. Wisconsin regulations also provide that "[a]ny water system serving 7 or more single family homes, 10 or more mobile homes, 10 or more apartment units, 10 or more duplex living units or 10 or more condominium units shall be considered a community water system unless information is provided by the owner indicating that 25 year-round residents will not be served." *Id.* § 811.02(16).
[74] *See* Ga. Envtl. Prot. Div. *supra* note 71.
[75] S.C. Code Ann. Regs. § 61-43-100.100(C)(1)(e), (2)(e), (3)(d) (with respect to swine waste utilization, "[t]he minimum separation distance in feet required between a manure utilization area and a public and private drinking water well is 200 feet.").
[76] For example, DENR should require greater setbacks from waters classified as "High Quality Waters (HQW)" or "Outstanding Resource Waters (ORW)." *See* 15A NCAC § 2B.0101(e) (HQW includes, among other categories of water bodies, "waters which are rated as excellent based on biological and physical/chemical characteristics through Division monitoring or special studies;" ORW are "unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses").
[77] Lawrence Papworth et al., Agtech Ctr., Investigation into Manure Incorporation of Various Tillage Methods (2001), *available at* http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng9949.

within twelve hours, as opposed to forty-eight hours, the general permit would avoid the unnecessary risk of runoff and exposure to odor.

H. Condition II.10

Proposed Condition II.10 requires Permittees to dispose of dead animals "whose numbers exceed normal mortality rates associated with the facility" in accordance with the facility's CAWMP and North Carolina Department of Agriculture and Consumer Service (NCDA&CS) Veterinary Division's statutes and regulations. DENR should ensure that the NCSA&CS Veterinary Division's statutes and regulations protect the environment and, if they do not, DENR should promulgate additional regulations and require additional provisions in the CAWMP that do. Given North Carolina's high water tables, burying animals poses a great risk to water resources and public health, and DENR should ensure its regulations protect against this risk.

DENR also should define "normal mortality rates" for each facility and require Permittees to report all die-offs in excess of those rates within 24 hours. In the event of a die-off in excess of the defined normal mortality rates, the Permittee should consult with DWR about appropriate burial locations. The Permittee should provide DWR a map of burial sites along with the dates and number of animals buried by species and type. DWR also should require groundwater monitoring for each so-called "massive burial of animals," which should be defined as any die-off in excess of the facility's normal mortality rate.

I. Condition II.12

Proposed Condition II.12 requires Permittees to establish a "protective vegetative cover" for all earthen lagoon/storage pond embankments, berms, pipe runs, and diversions to surface waters or wetlands. The General Permit should specify that the protective vegetative cover must be designed to prevent the berms and embankments from eroding and include criteria as to what is protective.

J. Condition II.17

Proposed Condition II.17 refers to inspections during land application of waste. DENR should remove the provision that allows the Permittee to "assert as an affirmative defense in any enforcement action alleging noncompliance with the requirements imposed in this condition that such noncompliance was due to circumstances beyond the Permittee's control." The permit should not incorporate an open-ended affirmative defense to potentially dangerous discharges. At a minimum, DENR should define the circumstances that will be considered "beyond the Permittee's control," such that it does not include preventable accidents or operator error.

K. Condition II.22

Proposed Condition II.22 prohibits land application of waste during precipitation events. This condition is very important to protecting water quality, but should be strengthened.

Currently, the condition requires land application to cease within four hours of the time that the National Weather Service issues a Hurricane Warning, Tropical Storm Warning, or Flood Watch associated with a tropical system for the county in which the permitted facility is located. This condition could be strengthened by requiring Permittees to cease land application at least twenty-four hours before the National Weather Service predicts, with an 80% certainty, that there will be two inches or more of rainfall in the county in which the permitted facility is located. Further, DENR should prohibit land application for at least twenty-four hours after the land receives two inches or more of precipitation (as gauged by on-site rain gauges, or as recorded by the National Weather Service).

The current four hour cessation period does not give the waste proper time to incorporate into the land, leaving it exposed to become part of the storm runoff. The recommended twenty-four hour cessation period would also allow for better management and monitoring for compliance.

L. Condition II.24

Proposed Condition II.24 requires, "[a]ll waste application equipment must be tested and calibrated at least once every two years. The results must be documented on forms provided by, or approved by, the Division." This condition should be amended to require the Permittee to test the equipment more frequently, at least once every six months, and submit the results of the testing to DWR.

M. Condition II.26

Proposed Condition II.26 provides that "[c]rops for which animal waste is land applied must be removed from the land application site and properly managed and utilized unless other management practices are approved in the CAWMP." DENR should define the term "removed" in a way that prohibits the practice of "storing" crops in bales (hay, Bermuda grass, etc.) around the exterior of sprayfields and/or crop fields not used as spray fields. Especially in times of drought, when the crops are denied other sources of water, the crops might have absorbed a lot of nutrients that could leach back out during the "storing" period.

N. Condition II.27

Proposed Condition II.27, which authorizes Permittees to temporarily lower lagoon levels in certain circumstances, should be revised to state that "an operator may temporarily lower lagoon levels only with the prior approval of the Division." As currently proposed, DWR is not ensuring that the decision to temporarily lower the lagoon will not impair water quality.

Instead, the condition purports to give Permittees authority to lower their lagoons, through excess land application, in anticipation of the hurricane season or in times of drought as long as the Permittee thinks the decision comports with NRCS Standards. In addition to requiring DWR approval before lowering the lagoon, DENR should clarify that nothing in Condition II.27 overrides Condition II.22, which, as proposed, requires land application to cease within four hours of certain storm warnings.

O. Condition III.1

Proposed Condition III.1 states that "lagoons/storage ponds, and other structures should be inspected for evidence of . . . leakage" on at least a monthly basis. This condition fails to suggest—let alone specify—a practical method for facility operators to determine whether a particular lagoon might be leaking. DENR should provide Permittees with guidance as to how to inspect the lagoons, and require more than mere visual inspections.[78]

The best method to conclusively measure the content and direction of seepage plumes would be to require broader installation and utilization of monitoring wells. Absent requiring additional monitoring wells, DENR could require the Permittee to install an evaporation pan to determine lagoon seepage loss.[79] Alternatively, DENR could require the Permittees to submit to third party testing for lagoon seepage, as other state agencies have done.[80] More advanced methods, requiring neither monitoring wells nor significant waste-withholding periods, have

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[78] Obviously, "visual observation," as indicated in the next sentence of Condition III.1, could not even be remotely effective at detecting seepage *at the bottom* of a seven-feet deep, sludge-filled lagoon.

[79] *See also* Nat'l Res. Conservation Agency, USDA, Agricultural Waste Management System Component Design – Part 651: Agricultural Waste Management Field Handbook 10D-40 (rev. 1, 2009), *available at* ftp.wcc.nrcs.usda.gov/wntsc/AWM/handbook/ch10.pdf (explaining that one approach to measure lagoon seepage loss "involves installing precise water level monitoring devices and evaporation stations. Seepage losses can be estimated by carefully monitoring the levels in the pond during periods when no waste is introduced into the pond and no rainfall occurs. After estimating the amount of evaporation, and subtracting that from the total decline in the level of the pond . . . , seepage losses can be estimated.").

[80] Idaho, for example, passed a 2009 rule stating that "[a]ll existing lagoons . . . shall be seepage tested by an Idaho licensed professional engineer, an Idaho licensed professional geologist, or by individuals under their supervision." IDAPA § 58.01.16.493; *see also* Idaho Dep't of Envtl. Quality, Guidance for Evaluating Wastewater Lagoon Seepage Rates (2009), *available at* http://www.deq.idaho.gov/media/516273-lagoon_seepage.pdf (guidelines "provided to assist wastewater lagoon owners and consultants to comply with the seepage test requirements of IDAPA 58.01.16.493"). For seepage test methods approved by other states, see Wis. Adm. Code NR § 208.05(h), Jan R. Hyngstrom et al., Univ. of Neb.-Lincoln Extension, Inst. of Agric. and Natural Res., Residential Onsite Wastewater Treatment: Lagoon Design and Construction (2010), *available at* http://ianrpubs.unl.edu/live/g1441/build/g1441.pdf *and* Or. Dep't of Envtl. Quality, Guidelines for Estimating Leakage from Existing Sewage Lagoons (1990), *available at* http://www.deq.state.or.us/wq/rules/div052/guidelines/estleak.pdf.

also been proven effective at measuring lagoon seepage.[81] Given the number and concentration of lagoons in North Carolina, it is past time for DENR to catch up with its counterpart agencies by including seepage test procedures in the revised General Permit.

P. Condition III.5

Under Condition III.5, DENR has proposed to require permitted facilities to analyze a representative sample of animal waste as close to the time of application as practical, but at least within 60 days of when the waste is applied (i.e., up to 60 days before, or 60 days after application). DENR requires the waste to be tested for four elements: nitrogen, phosphorus, zinc, and copper.[82] With this information, DENR ostensibly intends to ensure that the Permittee has information to inform whether and when it is appropriate to apply the waste to fields. Yet allowing the Permittee a four month window in which to test the waste is far too generous. The characteristics of the waste can change drastically over a four month period. For example, if waste is sampled in February, while it is accumulating in storage, but not applied until April, warmer seasonal temperatures will have altered the nutrient contents, making the cold-weather test results potentially misleading.[83] Thus, instead of allowing Permittees a four month window, DENR instead should require testing of the waste that actually will be applied, before application, so that the Permittee can assess conditions at the facility and plan when to apply the waste based on knowledge of its content.

Q. Condition III.9(f)

Proposed Condition III.9 sets forth the requirements of a discharge notice. In particular, under Condition III.9(f), the Permittee is required to analyze a sample of waste from the source lagoon/storage pond within seventy-two hours of knowledge of the discharge. In addition to requiring the Permittee to analyze a sample from the source lagoon/storage pond, DENR also should require the Permittee to test the water receiving the discharge for the parameters contained in Condition III.9(f). Both samples should be collected within 12 hours of the

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[81] *See, e.g.*, J.M. Ham & K.A. Baum, *Measuring Seepage from Waste Lagoons and Earthen Basins with an Overnight Water Balance Test*, 52 Am. Soc'y of Agric. and Biological Engineers 835 (2009) (introducing test capable of producing accurate seepage measurements in single overnight performance); J.M. Ham, *Seepage losses from animal waste lagoons: A summary of a four-year investigation in Kansas*, 45 Am. Soc'y of Agric. Eng'rs 983 (2002) (summarizing study performed using earlier variation of water balance method).
[82] In addition to testing the waste for nitrogen, phosphorus, zinc, and copper, DENR should follow advances in microbial source tracking ("MST") and consider requiring Permittees to test for MST markers in future versions of the permits. MST, also referred to as bacterial source tracking, broadly describes a group of methods that can be used to identify the source of fecal waste. Over the last few years, the science has significantly advanced, and there are several promising markers to identify the source of animal waste as well as a number of commercial laboratories that are able to complete the testing. With these markers, DENR and the Permittee will be in a better position to understand whether a discharge from a permitted facility contributed to water quality issues, a goal of Condition III.10.
[83] *See* Iowa State Univ. – Extension, How to Sample Manure for Nutrient Analysis 1-2 (Nov. 2003), *available at* http://www.extension.iastate.edu/publications/pm1558.pdf.

knowledge that there has been a discharge, not seventy-two hours. By seventy-two hours after a discharge, the contaminants in the receiving water could be quite dispersed, and the testing will not show the full impact of the discharge.

In addition, DENR should specify best practices for handling the samples. For example, both the sample from the source lagoon/storage pond and the sample from the receiving water should be kept on ice and taken to a certified laboratory within the time frame set forth under best scientific practices, usually within 24 hours.

DENR should also revise this condition to ensure that the Permittee provides the monitoring results to DWR as soon as possible, but at least within 15 days. Thereafter the information should be available to the public.[84]

R. Condition III.11

Proposed Condition III.11 requires the Permittee to maintain a copy of the facility's certificate of coverage, certification forms, lessee and landowner agreements, certified animal waste management plan and copies of all records required under the permit for three years. Rather than requiring the forms to be maintained for three years, the Permittee should be required to maintain this information for five years, the current term of the permit. Information required under the permit—like soil and waste analyses, rain gauge readings, freeboard levels, irrigation and land application event records, past inspection reports and operational reviews, animal stocking records, records of additional nutrient sources, cropping information, waste application equipment testing and calibration, and records of removal of solids to offsite locations—are important to understanding whether the Permittee has complied with the terms of the general permit and should be issued a new certificate of coverage. At the five-year review period, DENR should conduct a full compliance inspection of the facility, and review these records. However, under the current permit, the Permittee need not keep the pertinent records long enough to allow DENR to conduct a full compliance review. DENR currently requires facilities permitted under the National Pollutant Discharge Elimination System

[84] *See* Section III.X, *infra*.

("NPDES") program to maintain records for the entire term of the permit.[85] DENR should incorporate this best practice into the state general permit program, and amend Condition III.11 to require Permittee to maintain their records for five years.

S. Condition III.14

Proposed Condition III.14 gives the Director the discretion as to whether to require a Permittee to file an animal certification report based on compliance history. DENR should revise this condition to require all permitted facilities to submit a compliance report regardless of compliance history.

T. Condition III.15 to III.17

Proposed Conditions III.15, III.16, and III.17 set forth the steps the Permittee must follow when notifying DWR and the public that there has been a discharge of 1,000 gallons, 15,000 gallons, or 1,000,000 gallons or more of waste to surface waters or wetlands respectively. These conditions should be strengthened and standardized.

For example, DENR should use the same language across all three Conditions when describing the discharges. Condition III.15 refers to discharges of waste, while Condition III.16 refers to discharges of animal waste, and Condition III.17 refers to discharges of wastewater. The terms should be consistent across all three sections, and should be keyed to discharge of waste.

Conditions III.15 to III.17 require varying degrees of notice to DWR officials and the public. Condition III.15 requires the Permittee to issue a press release within forty-eight hours of a discharge of 1,000 gallons or more of waste to surface waters or wetlands. Rather than giving the Permittee forty-eight hours, however, DENR should require a press release as soon as possible, but at least within twenty-four hours so that nearby communities avoid using affected waters. DENR also should specify the contents of the press release, including all of the

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[85] *See, e.g.*, North Carolina Envtl. Mgmt. Comm'n, DENR, Swine Waste Management System NPDES General Permit, NPDES Permit No. NCA200000, Condition I.5 ("A copy of this Permit, the facility's COC, certification forms, lessee and landowner agreements, the CAWMP, and copies of all records required by this Permit and the facility's CAWMP shall be readily available at the facility (stored at places such as the farm residence, office, outbuildings, etc.) where animal waste management activities are being conducted for the life of this Permit, unless otherwise specified in this Permit. These documents shall be kept in good condition, and records shall be maintained in an orderly fashion."); *id.* Condition IV.20 ("All records required by this permit and the facility's CAWMP, including but not limited to soil and waste analysis, rain gauge readings, freeboard levels, irrigation and land application event(s), past inspection reports and operational reviews, animal stocking records, records of additional nutrient sources applied (including but not limited to sludges, unused feedstuff leachate, milk waste, septage and commercial fertilizer), cropping information, waste application equipment testing and calibration, and records of transfer of separated solids to off-site location(s), shall be maintained by the Permittee in chronological and legible form for a minimum of five (5) years. These records shall be maintained on forms provided by, or approved by, the Division and shall be readily available for inspection.").

information required under Condition III.16. DENR should revise Condition III.17 to make it clear that in the event of a discharge of more than 1,000,000 gallons, the Permittee must issue both the press release required under Condition III.15 and the public notice required under Condition III.16, expanded to include the appropriate counties recommended by DWR.

DENR also should revise these conditions to require the Permittee to contact DWR within twelve hours of a discharge of 5,000 gallons or more. DWR and the Permittee should work together to develop a speedy response plan.

Finally, in all three instances, DENR should require the Permittee to maintain a copy of the press release and public notice for up to one year, and to provide DWR a copy of the notice and proof of publication.

U. Condition III.18

Proposed Condition III.18 grants facilities that have sludge accumulation that does not satisfy the NRCS Conservation Practice Standard No. 359 two years to comply with a sludge removal and waste utilization plan. Two years is far too much time. If a facility is not meeting best practices to control sludge in its lagoon, it should execute a plan to rectify the sludge situation within a year, not two. In addition, if the facility is not able to manage its waste, it should not generate more.

V. Condition IV.1

DENR should clarify that facilities that are permitted under the general permit are subject to random, unannounced inspections. The qualifier that inspections and other monitoring be conducted at "reasonable times" should not limit the scope of DENR's authority to conduct unannounced inspections to ensure that the Permittee is complying with the terms of the permit and its CAWMP.

W. Condition V.13

Proposed Condition V.13 provides that "[u]pon abandonment or depopulation for a period of four years or more, the Permittee must submit documentation to the Division demonstrating that all current NRCS standards are met prior to restocking of their facility." Abandonment and depopulation of animal feeding operations is and will continue to be a concern in North Carolina. Animal feeding operations generate and accumulate a large amount of animal waste. Closing the facilities or letting them languish raises the consummate threat of system breach and discharge, as does reopening facilities that have not been properly closed. Thus, in addition to setting standards for reopening the systems, the general permit should provide or reference concrete requirements as to how lagoon or other waste management system should be closed. In addition, depopulated facilities with closed lagoons that contain waste must be required to maintain a permit, and facility owners and DENR must continue to inspect the lagoon to ensure that it is not leaking.

Moreover, the reopening requirements must do more to address the consummate threat of waste management system breach and discharge resulting from abandonment and depopulation. Merely requiring the Permittee to demonstrate compliance with current NRCS standards is insufficient. Instead, the Permittee should have to demonstrate compliance with the performance standards contained in General Statute § 143-215.10*I*. In re-opening, these facilities should be classified as "new" facilities regardless of whether they have retained their permit or not. At a minimum, before allowing the Permittee to re-open a facility that has been abandoned or depopulated, the Permittee should have to demonstrate that it is capable of complying with all legal parameters, including all aspects of its original permit and its CAWMP. Additionally, if the facility originally depopulated due to forced closure or enforcement, it should develop a detailed plan outlining the steps taken to rectify past violations.

X. Information Collection

DENR should revise the general permit to ensure that Permittees share all of the information collected under the permit with DENR, and that DENR in turn makes this information available to the public. Under the proposed permit, DENR requires the Permittees to monitor and record, or analyze the following:

- Assessments of the effectiveness the CAWMP (Condition I.3);
- Freeboard Levels (Condition III.2);
- The amount and type of precipitation for all precipitation events (Condition III.3);
- Soil fertility (Condition III.4);
- The amount of nitrogen, phosphorus, zinc, and copper in the waste (Condition III.5);
- Information and irrigation and land application events, including the date, hydraulic loading rates, nutrient loading rates, and cropping information, as well as information as to whether solids were removed and how those solids were disposed (Condition III.6);
- Waste transfers between structures on site that are not typically operated in a series (Condition III.7);
- Monthly stocking records (Condition III.8);
- Notification of discharges and other permit violations (Conditions III.9 and III.13); and
- Records of waste equipment testing and calibration (Condition II.24).

DENR only collects a select few of these records: the monthly stocking records and notice of discharge or other permit violations. DENR should collect all of this information on a quarterly basis, and maintain a database containing this information that is readily accessible to the public. The public and experts could use this information to more fully understand the effect these operations have on the environment and human health.

* * *

In addition to the issues raised above, the proposed general permits raised additional questions that we would be willing to discuss at a later date. For example, the undersigned have questions about the level of ponding allowed during waste application events (Condition II.5), when the permits allow spraying in windy conditions (Condition II.19), and the infrequency of the required soil fertility analysis (Condition III.4).

IV. DENR SHOULD REQUIRE DRY LITTER POULTRY FACILITIES TO OPERATE UNDER A PERMITTING PROGRAM

At the five-year renewal period, DENR should not only be taking a hard look at ways to strengthen the general permits, but also should review the decision not to require dry litter poultry facilities to obtain coverage under a general permit.[86] Under current North Carolina regulations, poultry operations that use a dry litter waste management system are "permitted by regulation" and do not need to obtain an individual permit or apply for a certificate of coverage under the proposed general permit for poultry operations, AWG300000.[87] Yet dry litter facilities are not adequately controlled under the current "permitting by regulation" scheme, and thus these regulations should be repealed. DENR should require these facilities to obtain a certificate of coverage under the general permitting program, or individual permits. In the meantime, DENR should require those facilities that violate the conditions for being deemed permitted to come under the general permit, or obtain individual permits, to continue operating.

Dry litter poultry operations threaten water quality and the health and welfare of neighboring communities. Many dry litter facilities store their waste outside in uncovered, unlined piles. For the large facilities (those housing more than 30,000 birds), the deemed permitting regulations simply require the waste to be applied or covered within 15 days.[88] However, for each of those 15 days, these unlined piles are exposed to the elements, risking a discharge to surface waters. Indeed, rain can wash the waste into nearby creeks and streams, and wind can blow the waste into waters. Moreover, the piles themselves also can leach waste into the ground, where it can contaminate groundwater and drinking water sources.[89] EPA itself recognized that dry litter poultry operations pose a risk to surface water and ground water

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[86] The signatories to this letter will continue to engage with DENR about the best way to regulate dry litter poultry facilities in the coming months.

[87] Dry litter poultry operations with 30,000 or more birds are deemed permitted if they meet five generic operational "criteria." 15A NCAC § 2T.1303(a)(2). All other dry litter operations are deemed permitted without condition, ostensibly because they are "[s]ystems that do not meet the criteria of an animal operation permitted under Rule .1304 or Rule .1305." 15A NCAC § 2T.1303(a)(1)-(2); *see also* N.C. Gen. Stat. § 143-215.10B(1) (defining "animal operation" so as to exclude dry litter operations).

[88] 15A NCAC § 2T.1303(a)(2)(D).

[89] For example, the photograph attached as Exhibit 3 shows piles of dry litter poultry waste exposed to the elements.

quality from improper storage of dry manure and improper land application.[90] The current system, therefore, does not protect North Carolina's water, air, or citizens from harmful pollution from the dry litter systems.

Covering these dry litter poultry facilities under a general permit program is an important first step to ensuring that they are not unduly burdening the environment and neighboring communities. For example, requiring dry litter facilities to affirmatively obtain a permit would bring them onto the radar screen. Given the current failure to affirmatively permit dry litter facilities, the state does not have a comprehensive list of the facilities and their locations, and thus does not routinely take steps to ensure that they are meeting even basic requirements to protect ground and surface water, such as covering waste.[91] In practical terms, DENR has relied on environmentalists and citizens to monitor these facilities and report violations, which provides only ad hoc and inconsistent information. Rather than waiting for environmentalists and citizens to inspect the facilities and report violations of the regulations, DENR should take a more active role and at the very least require the facilities to come under the general permit program.

DENR has the authority to require dry litter facilities to operate under the poultry waste management system general permit. Under North Carolina law, all animal waste management systems, including systems serving a dry litter poultry facility, must be permitted.[92] Nothing on the face of the proposed general permit limits its application to poultry facilities using a wet waste management system; the general permit indicates that it "may apply to any poultry facility in the State of North Carolina." Thus, DENR should repeal the permitting by regulation

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[90] *See* NPDES Permit Regulations and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, 68 Fed. Reg. 7,176, 7,208 (Feb. 12, 2003) (promulgating rules defining certain dry litter poultry facilities as concentrated animal feeding operations because "[n]utrients from large poultry operations continue to contaminate surface waters because of rainfall coming in contact with dry manure that is stacked in exposed areas, accidental spills, etc.) (codified at 40 C.F.R. pt. 412, subpt. D).
[91] *See* DENR, Tar-Pamlico River Basinwide Water Quality Management Plan at 22 (2010), *available at* http://portal.ncdenr.org/web/wq/ps/bpu/basin/tarpamlico/2010 ("Most poultry operations produce a dry litter by-product which is not regulated. The locations of poultry operations and the disposal of their waste is not known to environmental regulators due to the fact that there are no permitting requirements, making it very difficult to get a complete picture of the possible non-point sources contributions within a specific watershed. This makes managing and protecting water quality more challenging.").
[92] *See* N.C. Gen. Stat. § 143-215.1(a)(12) (requiring a permit to "[c]onstruct or operate an animal waste management system, as defined in G.S. 143-215.10B"). An animal waste management system is "a combination of structures and nonstructural practices serving a feedlot that provide for the collection, treatment, storage, or land application of animal waste." *Id.* § 143-215.10B(3). A feedlot, in turn, is "a lot or building or combination of lots and buildings intended for the confined feeding, breeding, raising, or holding of animals and either specifically designed as a confinement area in which animal waste may accumulate or where the concentration of animals is such that an established vegetative cover cannot be maintained." *Id.* § 143-215.10B(5). Dry litter poultry operations, thus employ animal waste management systems that must be permitted.

rules applicable to dry litter poultry facilities and exercise its authority to bring dry litter poultry operations under the general permits.

At a minimum, short of revising the regulations, DENR should immediately require facilities that violate the regulations allowing them to be "deemed permitted" to obtain coverage under an individual or general permit. One of the most frequently violated prohibitions under the permitting by regulation scheme is the prohibition against storing waste outside and uncovered for more than 15 days. Once a facility has stored its waste outside for more than 15 days, it is considered to have a wet waste management program[93] that immediately is subject to permitting under the current general permit, or in the event of a discharge, a National Pollutant Discharge Elimination System permit.[94] DENR has the authority to revoke the "deemed permitted" status in response to these violations and require the facilities to obtain coverage under an individual or general permit[95] yet DENR has yet to take even this basic step to protect water quality. Going forward, DENR should ensure that dry litter facilities that flout basic protections and threaten water quality immediately obtain an individual permit or a certificate of coverage under the general permit.

[93] According to recent EPA policy, poultry animal feeding operations "that stack or pile manure in areas exposed to precipitation are considered to have liquid-manure handling systems." *See* EPA, NPDES Permit Writers' Manual for Concentrated Animal Feeding Operations, EPA 833-F-12-001, § 2.2.4 at 2-8 (Feb. 2012), *available at* http://cfpub.epa.gov/npdes/afo/info.cfm. However, permitting authorities can authorize the temporary storage of litter outside in areas exposed to precipitation for less than 15 days, and such storage will not result in the system having a liquid-manure handling system. *Id.*

[94] Under North Carolina law, an agricultural feedlot with 30,000 or more confined poultry with a liquid animal waste management system is an animal operation. N.C. Gen. Stat. § 143-215.10B(1). DENR requires animal waste management systems for animal operations to obtain either a state general permit or a NPDES permit. *See* 15A NCAC §§ 2T.1304-05.

[95] *See* 15A NCAC § 2T.0113(e) ("The Director may determine that a disposal system should not be deemed to be permitted . . . and require the disposal system to obtain an individual permit or a certificate of coverage under a general permit. This determination shall be made based on existing or projected environmental impacts, compliance with the provisions of this Rule or other Permitted by Regulation rules in this Subchapter, and the compliance history of the facility owner.").

V. CONCLUSION

Thank you for the opportunity to provide comments on the proposed general permits for animal waste management systems. We appreciate the opportunity to provide input on North Carolina's permitting program and to work together to ensure that animal waste management systems throughout the state do not pollute North Carolina's water and air and operate consistently with principles of environmental justice.

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Exhibit 1

Exhibit 2

Exhibit 3

Exhibit 4

Industrial Hog Operations in North Carolina
Disproportionately Impact African-Americans, Hispanics and American Indians

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Summary

Background: In 2014, the North Carolina Department of Environment and Natural Resources (NC-DENR) issued a swine waste management general permit (the General Permit), which is expected to cover more than 2,000 industrial hog operations (IHOs). These facilities house animals in confinement, store their feces and urine in open pits, and apply the waste to surrounding fields. Air pollutants from the routine operation of confinement houses, cesspools, and waste sprayers affect nearby neighborhoods where they cause disruption of activities of daily living, stress, anxiety, mucous membrane irritation, respiratory conditions, reduced lung function, and acute blood pressure elevation. Prior studies showed that this industry disproportionately impacts people of color in NC, mostly African Americans.

Methods: We obtained records on the sizes and locations of permitted IHOs from NC-DENR and calculated the steady state live weight (SSLW) of hogs as an indicator of the amount of feces and urine produced at each IHO. We obtained block-level information on race and ethnicity from the 2010 census of the United States. We compared the proportions of people of color (POC), Blacks, Hispanics, and American Indians living within 3 miles of an IHO to the proportion of non-Hispanic Whites. We quantified relationships between race/ethnicity, presence of one or more IHOs, and the SSLW of IHOs, using Poisson regression and linear regression to adjust for rurality.

Results: Analyses based on a study area that excludes the state's five major cities and western counties that have no presence of this industry show that the proportion of POC living within 3 miles of an industrial hog operation is 1.52 times higher than the proportion of non-Hispanic Whites. The proportions of Blacks, Hispanics and American Indians living within 3 miles of an industrial hog operation are 1.54, 1.39 and 2.18 times higher, respectively, than the proportion of non-Hispanic Whites ($p<0.0001$). In census blocks with 80 or more percent people of color, the proportion of the population living within 3 miles of an industrial hog operation is 2.14 times higher than in blocks with no people of color. This excess increases to 3.30 times higher with adjustment for rurality. Adjusted for rurality, the SSLW of hogs within 3 miles of a census block increases, on average, 100,000, 64,000, 243,000, and 93,000 pounds for every 10 percent increase in POC, Black, Hispanic, and American Indian population ($p<0.0001$).

Conclusions: IHOs in NC disproportionately affect Black, Hispanic and American Indian residents. Although we did not examine poverty or wealth in this study, the results are consistent with previous research showing that NC's IHOs are relatively absent from low-poverty White communities. This spatial pattern is generally recognized as environmental racism.

Background

Swine production in North Carolina (NC) changed dramatically during the last decades of the 20th century. Between 1982 and 2006 the number of hog operations in the state declined precipitously while the hog population increased from approximately 2 to 10 million (Edwards and Driscoll 2009). Production became concentrated in eastern NC (Furuseth 1997).

Traditional NC producers raised small numbers of hogs, commonly fewer than 25, and hogs were one of several commercial crops on diversified farms (Edwards and Driscoll 2009). In contrast, industrial producers raise large numbers of hogs, often many thousands, in confinement houses that are designed to vent toxic gases and particles into the environment. Animal wastes are flushed into open cesspools and then sprayed on nearby fields. Pollutants emitted by IHOs include hydrogen sulfide, ammonia, a wide array of volatile organic compounds, and bioaerosols including endotoxins and other respiratory irritants (Cole et al. 2000) (Schiffman et al. 2001).

The negative impacts of particles and gases inside IHO confinements on worker health have been extensively described (Cole et al. 2000; Donham 1993; Donham et al. 1995; Donham et al. 2000; Donham 1990). Environmental pollutants from IHOs affect people who are more susceptible than workers due to young or old age, asthma or allergies, or other conditions. An extensive body of peer-reviewed scientific evidence shows that IHOs release contaminants into neighboring communities where they affect the health and quality of life of neighbors. Many of these studies have been conducted in NC. Hydrogen sulfide concentrations within 1.5 miles of IHOs in NC are associated with neighbors' ratings of hog odor and inability to engage in routine daily activities (Wing et al. 2008), increased stress and anxiety (Horton et al. 2009), irritation of the eyes, nose and throat, respiratory symptoms (Schinasi et al. 2011), and acute elevation of systolic blood pressure (Wing et al. 2013). A study of NC public middle school children who participated in an asthma survey, which was conducted by the NC Department of Health and Human Services, found that children attending schools within three miles of an IHO had more asthma-related symptoms, more doctor-diagnosed asthma, and more asthma-related medical visits than students who attended schools further away (Mirabelli et al. 2006). The same study reported a 23% higher prevalence of wheezing symptoms among children who attended schools where staff reported noticing livestock odor inside school buildings twice or more per month compared to children who attended schools where no livestock odor was reported (Mirabelli et al. 2006). Other studies in NC (Tajik et al. 2008) (Wing and Wolf 2000) (Bullers 2005) (Schiffman et al. 1995) and elsewhere (Donham et al. 2007) (Thu et al. 1997) (Radon et al. 2007) also document negative impacts of IHO air pollution on neighbors' health and quality of life.

Liquid contaminants from IHOs are released to the environment through leakage of animal waste storage pits, runoff from land application of liquid wastes, atmospheric deposition, and failure of the earthen walls of waste pits (Burkholder et al. 2007). Overflow of waste pits during heavy rain events results in massive spills of animal waste into neighboring communities and waterways. For example, in late September, 1999, 237 NC IHOs were located in flooded areas identified from satellite imagery provided by the NC Division of Emergency Management (Wing et al. 2002). Parasites, bacteria, viruses, nitrates, and other components of liquid IHO waste pose threats to human health (Burkholder et al. 2007; Cole et al. 2000).

Routine use of sub-therapeutic doses of antibiotics to promote weight gain of hogs promotes antibiotic resistance, making infections in humans more difficult to treat (Silbergeld et al. 2008). Airborne bacteria, including antibiotic resistant strains, have been isolated from IHO air emissions (Schulz et al. 2012) (Green et al. 2006) (Gibbs et al. 2006), and antibiotic resistant bacteria are associated with animal vectors near industrial animal operations, including flies (Graham et al. 2009), rodents (van de Giessen et al. 2009), and migratory geese that land on NC's IHO liquid waste pits (Cole et al. 2005). A recent medical records study from Pennsylvania shows that people living near IHO liquid waste application sites have elevated rates of infection with methicillin resistant *Staphylococcus aureus* (Casey et al. 2013). NC industrial livestock workers carry strains of *Staphylococcus aureus* that are associated with swine, including antibiotic resistant strains (Rinsky et al. 2013). These bacteria could be spread by liquid waste and airborne particles.

Using information from the United States Census of 1990 and locations of IHOs reported by the North Carolina Department of Environment and Natural Resources (NC-DENR) in 1998, we showed that the state's IHOs were disproportionately located in areas where more people of color (POC), primarily African Americans, live (Wing et al. 2000). We concluded that their disproportionate location in communities of color represented an environmental injustice. Since 1998 additional IHOs have obtained permission to operate and others are no longer in business. Additionally, between 1990 and 2010 the state's population size and spatial distribution changed due to births, deaths and migration. In this report we update our previous findings by evaluating whether IHOs operating under the general permit issued on March 7, 2014, will disproportionately impact POC, Blacks, Hispanics, and American Indians.

Materials and Methods

Lacking a list of the unique IHOs operating under the General Permit finalized in 2014, we used a list of all permitted industrial animal operations provided by NC-DENR on January 24, 2013 that we had prepared for prior research. First we excluded all non-swine operations from the list. Next we excluded swine operations with expired permits and permits with an allowable head count equal to zero. We also excluded permits that did not appear on a list of permitted animal operations published by DENR in January, 2014. We merged multiple permits issued for the same facilities to obtain a total head count for each operation. However the head count may be misleading as a measure of the pollution from each IHO because some facilities primarily house small pigs while others primarily house large hogs. We therefore calculated each facility's total steady state live weight (SSLW) using NC-DENR's formula based on the number and average weight of each growth stage of swine permitted at the facility. We interpret SSLW as a summary measure of the feces and urine produced by the swine of different growth stages at each facility.

Following the protocol provided in our previous study we excluded facilities operated by research institutions because they are subject to different location and management decisions than are commercial operations (Wing et al. 2000). Finally, we excluded facilities that do not hold a certificate of coverage to operate under the General Permit because they operate under individual permits or National Pollutant Discharge Elimination System general permits. The resulting facilities should closely approximate those expected to seek to continue operating under the renewed General Permit. The renewed General Permit takes effect on October 1, 2014, at which time we plan to update the list created for this research.

The vulnerability of people of any race/ethnicity to having polluting facilities nearby can be affected by the race and ethnicity of other people in their community. For example, African-Americans who live in areas primarily populated by non-Hispanic Whites have, generally, a lower susceptibility to being near polluting facilities than African-Americans who live in areas primarily populated by Hispanics or American Indians. We therefore conducted our primary analyses of disproportionate impact using the POC category. We also conducted analyses for specific racial/ethnic categories. We defined the following racial/ethnic categories: non-Hispanic White (non-Hispanics who identified as White and no other race), POC (all people not categorized as non-Hispanic white), Black (people who identified themselves as African-American or Black with or without any other race), Hispanic of any race, and American Indian (people who identified themselves as American Indian with or without any other race). We used block-level race/ethnicity-specific population counts from the US Census of 2010.

As large-scale agricultural facilities, IHOs are not located in major cities. Following the protocol adopted in our prior research, we defined a study area for our primary analyses that excluded census blocks in the five major metropolitan areas of NC (Charlotte, Winston Salem, Greensboro, Durham and Raleigh) as well as 19 western counties that neither have an IHO nor border a county that has an IHO. We conducted additional analyses for the entire state.

We considered residents of blocks to be affected by IHOs within three miles of the block centroid. Blocks were categorized as either having, or not having, an IHO within three miles. Additionally, we calculated the total permitted SSLW of hogs within three miles of the centroid of each block as a measure of the total potential influence of pollutants from nearby IHOs on the residents of the block.

As in our prior study, we also calculated the population density of each block, defined as the number of people per square mile. Population density is a measure of rurality, which is strongly related to the availability of land for agriculture and the price of land. Racial/ethnic groups in NC differ in their urban vs. rural residence, making them differentially susceptible to types of polluting facilities that locate in rural vs. urban locations. For example, a larger proportion of non-Hispanic Whites in NC live in remote rural areas than do Blacks, the racial comparison is affected not only by the susceptibility of Whites vs. Blacks to IHOs, but also by differences in whether they live in rural vs. urban areas. By adjusting for population density (or rurality), we compare racial vulnerability to IHOs for racial groups within each level of rurality. This adjustment is analogous to other statistical adjustments in epidemiology, as when the death rates of two countries are compared: even though death rates at every age may be higher in a poor than a rich country, the poor country may have a lower overall death rate simply because it has a younger age distribution. In that case, age-adjustment is used to compare mortality in the two countries just as we use density-adjustment to compare the proximity to IHOs in areas with different racial/ethnic make-up.

We used weighted Poisson regression to quantify relationships between race/ethnicity and the presence of one or more IHOs within three miles of a block. We used weighted linear regression to quantify relationships between race/ethnicity and the SSLW of hogs permitted within three miles of a block. We used census block populations as weights. In density-adjusted models we included variables for the natural log of population density raised to the first, second and third power. As in our prior analysis, this cubic model fit the data well and additional power terms added little to the model fit (Wing et al. 2000). For the two largest racial/ethnic groups other than non-Hispanic Whites, POC and Blacks, we categorized race/ethnicity in groups of blocks 20% in width compared to blocks with no POC using indicator variables. Due to smaller numbers in these categories we did not fit models with indicator variables for Hispanics and American Indians. We also considered the percent of population of each race/ethnicity as a continuous variable, estimating the added burden of IHOs for a 10% increase in the population.

This study involves neither random sampling nor randomization of exposure to IHOs, therefore statistical significance testing is inappropriate and confidence intervals do not correspond to the probability that the true values of measures of association are within the interval. However, the US-EPA considers statistical significance in its assessment of environmental racism. We therefore report p-values for differences in proportions of each racial/ethnic group within 3 miles of an IHO using t-tests. We report 95% confidence intervals (CIs) as measures of precision of the associations estimated from regression models. 95% CIs that exclude the null value (1.0 for ratios and 0.0 for differences) are commonly considered to be statistically significant at $p<0.05$.

Results

We estimate that 2,055 IHOs were operating under the General Permit in January 2014, and that they were permitted to house approximately 1.2 billion pounds of swine (Table 1). The 160 (7.7%) IHOs permitted to house between 20 and 100 thousand pounds accounted for only 1% of the total permitted SSLW. The 342 (17.2%) IHOs permitted to house between 1 and 10.2 million pounds accounted for 46.5% of the total.

Table 2 shows that there are over 6.5 million residents of the study area. Approximately 986,000 (15.1%) of these live in census blocks whose centroid is within 3 miles of an IHO that operates under the General Permit. This includes 602,380 non-Hispanic Whites and 383,522 POC. 13.1% of non-Hispanic Whites and 19.9% of POC in the study area live in blocks within 3 miles of an IHO.

Based on the study area population in Table 2, Table 3 shows ratios of percentage of POC living within 3 miles of an IHO compared to the percentage of non-Hispanic Whites living within 3 miles of an IHO. The percentage of POC living within 3 miles of an IHO is 1.52 times higher than the percentage of non-Hispanic Whites. The percentages of Blacks, Hispanics and American Indians living within 3 miles of an IHO are 1.54, 1.39 and 2.18 times higher, respectively, than non-Hispanic Whites. If residents of the study area had been randomized to live within 3 miles of an IHO, the probabilities of observing differences of these magnitudes or greater are less than 0.0001; the observed differences are considered to be highly statistically significant.

We calculated these same ratios based on the entire state population of 9,535,483. The percentages of POC, Blacks, Hispanics and American Indians living within 3 miles of an IHO are 1.38, 1.40, 1.26 and 2.39 times higher than the percentage of non-Hispanic Whites, respectively. These ratios are considered to be highly statistically significant.

Figure 2 shows the percent of people living within 3 miles of an IHO in relation to the percent of people of color in blocks. In areas with less than 20% POC, just over 10% of the population lives within 3 miles of an IHO. In areas with 60-80% POC, over 20% of the population lives so close to an IHO. In areas with more than 80% POC, more than a quarter of the population lives within 3 miles of an IHO.

Table 4 presents ratios of the percent of people living within 3 miles of an IHO in blocks with >0 to <20%, 20 to <40%, 40 to <60%, 60 to <80% and 80 to 100% POC compared to blocks with no POC. The total population in these categories ranges from 526,305 in blocks with 60 to <80% POC to 2,577,015 in blocks with >0 to <20% POC. Ratios are statistically significantly elevated for all areas with more than 40% POC with or without adjustment for rurality. Ratios on the right side of Table 4 are adjusted for rurality. These ratios increase with the percentage POC. The highest ratios occur in areas with more than 80% POC, where over three times as many people live near IHOs, adjusted for rurality, compared to areas with no POC. These excesses are considered to be highly statistically significant.

Table 5 shows the results of analyses for Blacks parallel results to in Table 4 for all POC. Although ratios are somewhat lower for Blacks than POC, the percent of people living within 3 miles of an IHO is statistically significantly elevated in all groups of blocks that are more than 40% Black, with or without adjustment for rurality. In areas that are 80% or more Black, twice as many people live within 3 miles of an IHO compared to areas with no Blacks, a disparity that increases to three times more with adjustment for rurality. These excesses are considered to be highly statistically significant.

Table 6 presents the increased percent of the population living within 3 miles of an IHO for each additional 10 percent of the population of POC, Blacks, Hispanics, and American Indians. This analysis is similar to the results in Tables 4 and 5, but rather than using categories, the relationship between race/ethnicity and proximity to IHOs is modelled as a linear function. For every ten percent increase in POC, the proportion of people residing within 3 miles of an IHO increases, on average, by 10.7%. These values are 9.4, 8.5, and 16.2 for Blacks, Hispanics, and American Indians, respectively. Adjusting for rurality, 14.8% more people reside within 3 miles of an IHO for each additional ten percent POC. Adjusted values are 13.0, 16.3 and 11.8 for Blacks, Hispanics and American Indians, respectively. These linear relationships between race/ethnicity and living near IHOs are considered to be highly statistically significant.

Table 7 shows the difference in SSLW of hogs within 3 miles of residents of blocks with >0 to <20%, 20 to <40%, 40 to <60%, 60 to <80% and 80 to 100% POC compared to blocks with no POC. Blocks in categories with more than 20% POC have, on average, between 177 and 510 thousand pounds more hogs within 3 miles than blocks with no POC. Adjusting for population density, blocks with more than 60 percent POC have, on average, more than three-quarters of a million pounds more hogs permitted within 3 miles than areas with no POC. These excesses are considered to be highly statistically significant.

Table 8 presents parallel results for percentage Black population. As for POC, areas with more than 20% Black residents have an excess SSLW of hogs compared to areas with no Black residents, and differences are greater with adjustment for rurality. Adjusted for population density, blocks with more than 40% Black residents have between 493,000 and 620,000 more pounds of hogs within 3 miles than areas with no Black residents. These excesses are considered to be highly statistically significant.

Table 9 provides the average additional SSLW of hogs permitted in areas with POC for each percent increase in specific racial/ethnic categories. Adjusted for population density, the permitted SSLW of hogs within 3 miles of blocks increases 100, 64, 242, and 92 thousand pounds for each ten percent increase in POC, Black, Hispanic, and American Indian population, respectively. These linear relationships between race/ethnicity and SSLW are considered to be highly statistically significant.

Figure 3 depicts the data analyzed above. Each dot represents an IHO that was operating under the General Permit in 2014. IHOs are concentrated in NC's Coastal Plain Region, between the Piedmont and Tidewater. The red areas of Figure 3 indicate that this region has more people of color than other parts of the study area.

Conclusion

IHOs operating under the NC-DENR General Permit in 2014 are disproportionately located near communities of color. The disparities are considered to be highly statistically significant for Blacks, Hispanics, American Indians, and all POC. IHOs pollute local ground and surface water. They routinely emit air pollutants that negatively impact the quality of life and health of nearby residents. In addition to their well-documented effects on physical, mental and social well-being, residents of areas with a high density of IHOs, and especially residents of color, have been subjected to intimidation including threats of legal action, violence, and job loss (Wing 2002). The industry's close ties with local and state government officials help it to avoid regulation that could protect neighbors, and creates barriers to democracy in rural communities of color (Thu 2001, 2003). These discriminatory impacts could be reduced by decreasing the density of production and use of technologies that prevent releases of pollutants.

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Figure 1
North Carolina study area, 2014

Figure 2
Percent of population living within 3 miles of an IHO
in relation to percent people of color, NC, 2014

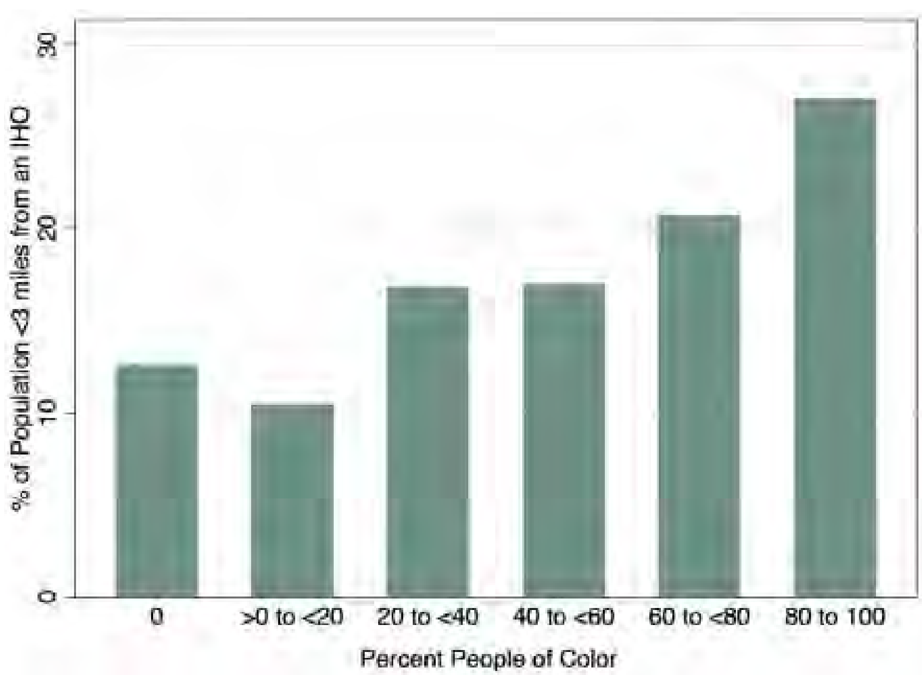

Figure 3
Racial and ethnic composition of census blocks and the locations of NC IHOs operating under the General Permit, 2014

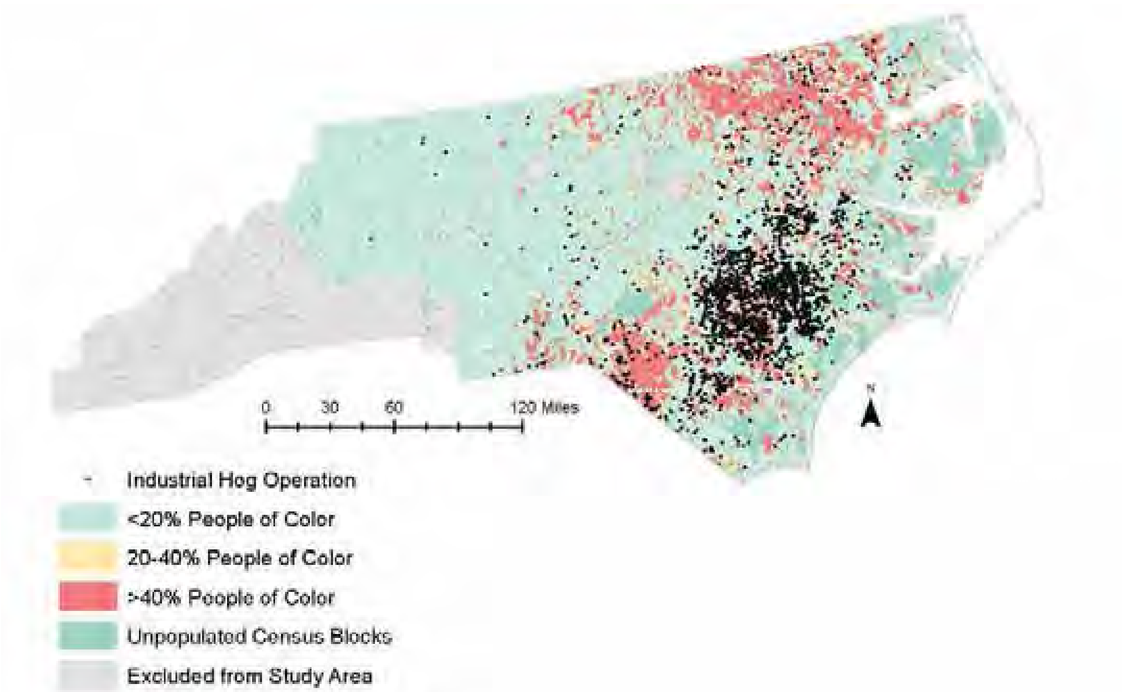

Table 1
Steady state live weight of IHOs
operating under the General Permit, NC, 2014

Permitted SSLW[1]	Number of IHOs	Percent of IHOs	Total SSLW[1]	Percent of total SSLW
20-	160	7.7	12,574	1.0
100-	447	21.6	76,626	5.9
250-	577	28.1	222,003	17.1
500-	529	25.4	383,918	29.6
1,000-10,200	342	17.2	603,354	46.5
Total	2055	100.0	1,298,474	100.0

[1]Thousands of pounds

Table 2
Racial and ethnic composition of NC census blocks within 3 miles
of an IHO and more than 3 Miles of an IHO, 2014

	≤3 miles from an IHO		>3 miles from an IHO		
Racial Category	Number	Percent	Number	Percent	Total[1]
Non-Hispanic white	602,380	13.1	4,003,455	86.9	4,605,835
POC[1]	383,522	19.9	1,548,276	80.1	1,931,798
Black	277,199	20.2	1,096,795	79.8	1,373,994
Hispanic	92,679	18.1	418,292	81.9	510,971
American Indian	40,621	28.5	101,872	71.5	142,493
Total[1]	985,902	15.1	5,551,731	84.9	6,537,633

[1]POC can be counted in more than one racial/ethnic category. The total population is equal to the number of non-Hispanic Whites plus the number of POC.

Table 3
Ratios of POC compared to non-Hispanic Whites living within 3 Miles of an IHO operating under the General Permit, 2014

Racial/ethnic Category	Population	≤3 miles from an IHO Number	Percent	Ratio[2]	p-value[3]
Non-Hispanic white	4,605,835	602,380	13.1	1.00	--
POC[1]	1,931,798	383,522	19.9	1.52	<0.0001
Black	1,373,994	277,199	20.2	1.54	<0.0001
Hispanic	510,971	92,679	18.1	1.38	<0.0001
American Indian	142,493	40,621	28.5	2.18	<0.0001
Total[1]	6,537,633	985,902	15.1		

[1]People of color can be counted in more than one racial/ethnic category. The total population is equal to the number of non-Hispanic Whites plus the number of POC.
[2]Ratio of the percent of people of other racial/ethnic groups to percent of non-Hispanic Whites living within 3 miles of an IHO
[3]A difference in proportions of this magnitude or greater would be expected to occur less than one time in ten thousand if people of different racial/ethnic groups had been randomized to live within 3 miles of an IHO.

Table 4
Ratios comparing the percent of people residing within 3 miles of an IHO in blocks with POC compared to blocks with no POC

Percent POC	Population	Unadjusted Prevalence Ratio	95% CI	Adjusted[1] Prevalence Ratio	95% CI
0	694,747	1.0	referent	1.00	referent
>0 to <20	2,577,015	0.83	0.82, 0.83	1.01	1.00,1.02
20 to <40	1,364,923	1.34	1.33, 1.45	1.95	1.93, 1.97
40 to <60	799,124	1.35	1.34, 1.36	2.15	2.13, 2.16
60 to <80	526,305	1.64	1.62, 1.65	2.53	2.50, 2.55
80 to 100	575,519	2.14	2.12, 2.16	3.30	3.27, 3.32

[1]Adjusted for rurality using a cubic polynomial of the natural log of population density

Table 5
Ratios comparing the percent of people residing within 3 miles of an IHO in blocks with Black residents compared to blocks with no Black residents

Percent Black	Population	Unadjusted Prevalence Ratio	95% CI	Adjusted[1] Prevalence Ratio	95% CI
0	1,308,061	1.00	referent	1.00	referent
>0 to <20	2,941,746	0.93	0.92, 0.94	1.20	1.19,1.21
20 to <40	1,043,277	1.44	1.43, 1.45	2.07	2.05, 2.08
40 to <60	536,198	1.52	1.51, 1.53	2.18	2.17, 2.20
60 to <80	336,232	1.57	1.56, 1.59	2.19	2.17, 2.21
80 to 100	372,119	2.01	1.99, 2.02	3.06	3.04, 3.09

[1]Adjusted for rurality using a cubic polynomial of the natural log of population density

Table 6
Percent difference in the percent of people residing within 3 miles of an IHO for a ten percent increase in the population of each racial/ethnic group

Racial/ethnic group	Unadjusted Percent	95% CI	Adjusted[1] Percent	95% CI
POC	10.7	10.6, 10.8	14.8	14.7, 14.9
Black	9.4	9.3, 9.4	13.0	12.9, 13.1
Hispanic	8.5	8.4, 8.6	16.3	16.1, 16.4
American Indian	16.2	16.0, 16.4	11.8	11.6, 12.0

[1]Adjusted for rurality using a cubic polynomial of the natural log of population density

Table 7
Difference in SSLW of hogs within 3 miles of residents of blocks with POC compared to blocks with no POC

Percent POC	Unadjusted SSLW[2]	95% CI	Adjusted[1] SSLW	95% CI
0	Referent	-	Referent	-
>0 to <20	-35	-73, 3	190	154, 227
20 to <40	177	136, 219	535	495, 575
40 to <60	308	262, 353	717	672, 762
60 to <80	510	459, 561	896	846, 946
80 to 100	453	403, 503	837	788, 885

[1]Adjusted for rurality using a cubic polynomial of the natural log of population density
[2]1,000s of pounds

Table 8
Difference in SSLW of hogs within 3 miles of residents of blocks with Black residents compared to blocks with no Black residents

Percent Black	Unadjusted SSLW[2]	95% CI	Adjusted[1] SSLW	95% CI
0	Referent	-	Referent	-
>0 to <20	-4	-33, 25	237	207, 265
20 to <40	190	153, 227	493	457, 530
40 to <60	327	281, 372	620	576, 665
60 to <80	275	221, 330	547	494, 599
80 to 100	165	113, 218	494	444, 545

[1]Adjusted for rurality using a cubic polynomial of the natural log of population density
[2]1,000s of pounds

Table 9
Difference in SSLW of hogs within 3 miles of residents of blocks for a ten percent increase in population of each racial group

Racial/ethnic group	Unadjusted SSLW[2]	95% CI	Adjusted[1] SSLW	95% CI
POC	67	63, 71	100	96, 104
Black	38	34, 42	64	60, 68
Hispanic	183	174, 192	242	234, 251
American Indian	124	111, 137	92	80, 105

[1]Adjusted for rurality using a cubic polynomial of the natural log of population density
[2]1,000s of pound

Exhibit 5

ANONYMOUS DECLARATION I

1. It is my wish for my name to remain anonymous for this statement. I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American and live in the town of Wallace, in Duplin County, North Carolina. I live here with my family

3. I am thirty-one years of age.

4. I live with my family here in Wallace, near a hog farm. There are several farms within a quarter-mile of my house in every direction. One of the farms sprays very close to the right side of my home.

Experience Living Next to the Hog Facility

5. I can't sit out on the porch because the smell from the hog farms is unbearable, especially when it's hot outside.

6. I had a friend who lived down the road and when I went to visit him, I often would see a mist of hog waste coming off the fields from where the farms where spraying. Because I wanted to see my friend, and had no other way of getting there, I would walk down the road anyway, but I was careful to cover my mouth and nose with my shirt so that I didn't have to breathe in the hog waste.

7. My mom and sister used to go down the road sometimes, but often they would have to turn around and come back home because the smell from the hog farms was so bad. We all used to go further down the road together when I was young, but the smell has gotten worse over time, and it has prevented us from taking walks outside.

8. It seems as if the hog farm sprays near my home around three times per week at inconsistent times of the day.

9. The odor is terrible when they spray, especially when it's hot outside. I try to be gone a lot, to stay with a friend who does not live near a hog farm. I try not to come home or be outside when they are spraying.

10. My eyes get watery from the smell of the hog waste. The closest farm to us used to have just one sprayer that gushed the waste. Recently, the farm installed little sprinklers – maybe five or six sprinklers that are set out around the sprayfield. The new sprinkles have finer streams, but they have not stopped the smell. The farmer also planted trees at the farm closest to my home to try to block the mist and hide the lagoons like they don't even exist. The trees help block some of the mist that used to get into our yards, but it hasn't stopped the problem. My family can still smell when they spray. It's hardly liveable.

11. There are people in my family with chronic health conditions already. Living near the hog farms does not help.

12. I have concerns about living near the hog farms. We use the town water for laundry, watering plants, and brushing our teeth. We do not use the well water anymore because we think it may be contaminated from the hog farms.

13. I don't grill outside or have cookouts because of the smell from the hog farms. My dad cooked outside for my uncle's funeral, but everyone stayed inside while he was cooking and when we were eating because we didn't want to smell the hog farms. When my dad was younger he used to grill a lot and have a lot of cookouts. We stopped having family gatherings and cookouts here because of the smell from the hog farms. We don't host family events here anymore unless we can stay inside, away from the smell from the hog facilities. We would like to have more family gatherings here, but it's hard to do it because of the spray smell.

14. My great-grandmother used to leave clothes outside to dry, but when the hog facilities moved into our area, she couldn't do it anymore. If she left the clothes on the line, there would be little yellow spots on them from the mist from the hog waste. My family complained to the hog farmers about how the spraying was ruining our clothes, and preventing us from being outside, but they do not seem to care. They are rude and mean to my family, and have refused to clean up their act.

15. I think property values are low here because we are so close to the hog farms.

16. I have talked with other people in my community about how we can try to fix the problem of all the hog farms polluting our town and affecting our health and welfare. It's not good that there is so much waste, and it's all very close. Most people are quiet about the hog farm issue. The hog farms are all around, so people must figure it is legal, but it should not be legal for the hog farms to spray waste where people live, and pollute the air and water and affect people's health.

17. I think North Carolina needs to change the law to protect communities from the hog farms. The hog farms need to use a better way to treat their waste. The hog farms should be responsible for figuring out a better way to dispose of the hog waste because they are the ones that are making money off of the hogs. The waste is part of their business, and they should be responsible for cleaning up.

18. I'm protective of my family. They're clearly frustrated that the hog farms are allowed to pollute our air and water and harm the community and it is wearing them down. I want to leave this area—because it's so hard to live near the hog farms—but I'm very close to my family and they are all concentrated around here. The hog farms cannot make us move off of our property.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Statement verified in Duplin, North Carolina on August 29, 2014.

Exhibit 6

DECLARATION OF [redacted]

1. My name is [redacted] I was born on July 18, 1956, and am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I have lived in New Bern, North Carolina since September 28, 2002. My current address is [redacted]

3. I have experience with swine confined animal feeding operations (CAFOs) as a resident of eastern North Carolina, as the former Lower Neuse Riverkeeper, and, now, working with Riverkeepers across Eastern North Carolina, as the North Carolina CAFO Coordinator for Waterkeeper Alliance. My bio is attached as Exhibit 1.

4. I earned a Bachelor of Science Degree in GeoEnvironmental Studies at Shippensburg University in Shippensburg, Pennsylvania in December, 2001. My undergraduate studies focused on wetlands, water quality and water management.

5. I interned with the Chesapeake Bay Foundation in the Harrisburg, PA office during college and was an active volunteer there for more than twenty years, working on oyster recovery and public education. I also volunteered for the Oyster Recovery Partnership in Maryland and was recognized as their Volunteer of the Year in 2001.

6. Before becoming the Lower Neuse Riverkeeper, I was employed by Helicopter Applicators, Inc., Gettysburg, PA Field Operations, where I conducted on-site aerial monitoring of forest fires using remote sensing equipment mounted on a helicopter and production of maps used to fight the fires, and by EMS Environmental, in Frederick, Maryland, as a field technician installing and monitoring Soil Vapor Extraction Systems.

7. I became the Lower Neuse Riverkeeper, headquartered in New Bern, North Carolina on October 1, 2002. My responsibilities primarily included the protection of the Lower Neuse River and public education about issues impacting the

health of the Lower Neuse. The Lower Neuse extends from a line at Goldsborough, North Carolina, downstream to the mouth of the river. At the same time, I did some work on the whole Neuse River, together with the Upper Neuse Riverkeeper, and on the protection of the entire watershed.

8. As Lower Neuse Riverkeeper, I raised awareness about the needs of a healthy Neuse River and worked to affect change at all levels of government, while also aiming to move government regulatory agencies to hold accountable those who would threaten the health of the Neuse. I worked with a range of volunteers, including volunteer creekkeepers, who help monitor specific tributaries of the Neuse, volunteer private airplane pilots who provided me with the ability to scan the river from the air, individuals who conducted research and documented chronic polluters, as well as lobbyists who travelled to government offices at the state and federal levels to request support for good environmental regulations.

9. My responsibilities also included water monitoring and testing, to determine the concentration of nutrients and bacteria from sources of waste that are getting into the waterways. I primarily looked at fecal coliform, nitrogen, phosphorus and ammonia, but included other testing parameters depending upon the circumstances. I became involved in testing soon after becoming the Lower Neuse Riverkeeper, and I continue to do water testing to the present.

10. I have also been active in America Rivers, River Network, NC Conservation Network and the Eastern Carolina Coastal Caucus, have served on the advisory board for Pamlico Community College and Kinston Waterfront Now!, and have been a member of the Craven County Water Use Reduction Committee, local Emergency Planning Committee, Crystal Coast Disaster Coalition. I am a past [redacted] (b) (6) Privacy for Rural Empowerment for Community Help (REACH), and received the 2012 Florenza Moore Grant Environmental Justice Award from the NC Environmental Justice Network. I was entered into the United States Congressional Record, House of Representatives, on May 9, 2012 by Congressman Dennis Kucinich for my work to protect the Neuse River

watershed. I am frequently requested to provide expertise on environmental topics to other government, civic and private organizations.

11. On November 3, 2011, I started working for the Waterkeeper Alliance as a contractor on CAFO monitoring and sampling, primarily in the Cape Fear Watershed. In May, 2012, I became full time staff for Waterkeeper Alliance. In this current position, I help with monitoring, sampling, and coordination among eight Riverkeeper programs in North Carolina that are also dealing with CAFOs – swine, poultry and cattle – and I provide assistance to them on the design and implementation of CAFO monitoring programs in their watersheds. The eight Riverkeepers include the Catawba Riverkeeper, the Yadkin Riverkeeper, the Neuse Riverkeeper, the Pamlico Tar Riverkeeper, the French Broad Riverkeeper, the White Oak New Riverkeeper, the Cape Fear Riverkeeper, and the Waccamaw Riverkeeper. I also provide, when requested, assistance, guidance and support for Waterkeeper Alliance member programs in the United States as well as internationally, as well as providing assistance to other non Waterkeeper Aliance afilliated organizations and members of the concerned public.

12. The Waterkeeper Alliance is a nonprofit organization that unites more than 200 Waterkeeper organizations in North Carolina, across the United States, and around the world, focusing citizen action on issues that affect our waterways, from pollution to climate change. Waterkeeper Alliance's Pure Farms, Pure Waters Campaign recognizes that CAFOs and the rise of corporate controlled meat production have nearly destroyed the family farm and severely poisoned our nation's water resources. It is my understanding that the industry, including feed production, is the leading cause of nutrient and pathogen impairment of rivers and lakes across the United States.

13. In my current role, I assist and guide Riverkeeper programs in North Carolina in their efforts to address the impacts of CAFOs, which are a major source of pollution to the waters and the environment of the state.

14. As Lower Neuse Riverkeeper and, more recently, in my position at Waterkeeper Alliance, I have worked with other groups, including the North Carolina Environmental Justice Network and REACH, as well as their members. Swine CAFOs not

only affect the waters and the environment of the state, generally, but they have a disproportionate impact on the health and quality of life of African American, Hispanic and low income communities in North Carolina and are an issue of environmental justice in the state. Working on issues related to CAFOs opened my eyes to environmental justice issues.

Impacts of Swine Waste

15. As the Lower Neuse Riverkeeper, I became aware of the impacts of swine farms immediately. Rick Dove, my predecessor and also a board member at the Neuse Riverkeeper Foundation, had been dealing with swine CAFOs for a long time. It quickly became evident that CAFOs were one of, if not the largest contributors of nutrients to the Neuse River. This remains true to this day.

16. In the beginning the issue was primarily environmental, and, in particular, the impact on water quality throughout swine country. I was initially focused on the Neuse River but then I began helping in other watersheds where CAFOs were also having an impact. High concentrations of nutrients and bacteria from swine waste were leaving the facilities as runoff and getting into waterways. In many cases, I saw the runoff coming off the fields through ditches and into waterways. Through testing and monitoring we saw that this runoff was having an impact through high levels of nutrient and bacteria – in particular, fecal coliform, nitrogen, phosphorus and ammonia.

17. As Lower Neuse Riverkeeper, I got involved in sampling almost immediately and continued sampling in the watershed throughout the time I served as the Riverkeeper. I generally sampled at least weekly, though not necessarily at the same site. I sampled at a number of facilities where we had reason to believe there might be a problem. Concerns were raised because someone reported runoff or spraying right into a ditch, because excessive spraying or other problems were observed on fly overs, or for some other reason. Three photographs that I took of examples of runoff from hog facilities on January 2012, in Duplin County, March 2013 in Duplin County, and March 2013 in Greene County are attached as Exhibits 2, 3, and 4, respectively.

18. When I sample, I follow the Standard Surface Water Sampling Protocol established by the United States Environmental Protection Agency (EPA). This includes the use of personal protective gear (gloves and boots), which is a standard practice and is a requirement to protect the integrity of the sample or samples, as well as to protect the individual sampler from coming in contact with potentially harmful constituents in the sample. Samples are properly labeled to ensure accurate documentation.

19. The Protocol also focuses on acquiring samples in ways that ensure that the samples are not cross contaminated, and in appropriate circumstances, the sampler acquires the sample from the downstream position of the sample site. Once acquired, the samples are preserved by being placed into an ice cooler with ice for transport to a North Carolina state certified laboratory. Chain of Custody forms, as required by the state certified laboratories, are properly maintained during the transport of the samples.

20. When sampling water, I have to be careful. I wear personal protective gear both to prevent contamination of the samples and to protect my skin from exposure. It is my understanding that Rick Dove suffered from an infection as a result of his contact with area waters.

21. The odor from swine CAFOs can be very strong. I have experienced the odor from my car, during monitoring activities, and more generally when I am traveling around the area.

22. When exposed to odor from swine CAFOs, my colds last longer and I have had a hacking cough that seemed to last a long time. Exposure to air pollution from CAFOs has exacerbated health problems from what is normal for me.

23. In my current position, I participate in fly overs, which are opportunities to go up in a plane to observe the facilities from above and to take aerial photographs throughout the state. On these flights, I have seen waste sprayed directly over a ditch, liquid waste from a sprayer leaving a property as a result of wind drift, and spraying into a wetland or creek. In at least one case, I have seen gullies that developed on the sprayfield, which lead to the waterway, in this case Stocking Head Creek. The erosion of

the sprayfield creates a direct conveyance of waste off of the property. I have attached three photographs of such gullies taken in August 2013 in Beaufort County, August 2013 in Beaufort County, and February 2014 in Duplin County as Exhibits 5, 6, and 7, respectively.

24. On fly overs, I have also seen the burial of dead animals and issues dealing with lagoon levels.

25. Some of the areas in eastern North Carolina with the heaviest concentration of swine CAFOs – for example, in Duplin County, also have a high concentration of poultry facilities. With the completion of a new chicken slaughterhouse in Kinston, NC that reached full production in January, 2013, the number of poultry facilities increased dramatically and were concentrated in a roughly 50 mile radius of the new slaughterhouse. During fly overs, I have also seen piles of poultry waste that are out in the field and, also, the applications of poultry waste on fields.

26. In Duplin and surrounding counties, the co mingling of facilities – hogs, poultry and also cattle grazing on the same properties – adds to the level of concern about the concentration of nutrients from waste.

27. The spread of disease is also a concern, with infections spreading from one species to the next – avian flu translating into swine flu, for example. Concerns about the spread of disease are heightened because of the methods used by swine CAFOs for disposing of mortalities. Porcine Epidemic Diarrhea virus (PEDv) has been impacting North Carolina since approximately June 2013 and continues to decimate swine herds. Impacting the piglets, to my knowledge PEDv still has no known effective antibiotic that is even slowing down the impact of this disease. Although actual figures are not available, with as many as 3 million piglets that have died in the state, this virus adds to the need to dispose of dead animals, which in this case is done by burying carcasses, further raising concerns about contamination of surface and ground water.

28. There's a certain percentage of mortality in all CAFOs. When the animals die, the CAFO operators need to do something with the bodies. There are four methods of carcass disposal in Eastern North Carolina. First, burial, which involves digging a hole

in the ground on the property and covering it up. The second is incineration whereby operators have a furnace on the property where the dead animals are burned. The third method is composting. Dead animals are mixed in with other products and allowed to decompose. The compost may then be used for fertilizer. Composting is not in widespread use as a method of disposing of swine mortalities here.

29. Finally, many facilities collect mortalities and put them in a dumpster, which is known as a "dead box." These dead boxes are usually at the end of the driveway leading to the facility. Trucks then pick up the dead bodies for rendering at a rendering plant, where the animals are used for parts that have commercial value.

30. I have a number of concerns about the disposal of mortalities in dead boxes. Often, the bodies are exposed to the elements, and the animals are exposed to predators such as buzzards or animals on the ground. Dead boxes have covers but I have seen dead boxes where the cover is not being used many times. Second, there is the issue of flies and odor. Third, these dumpsters leak liquid, either because of precipitation or from liquid from the animals themselves. Sometimes dead boxes sit in the sun for days. I have a concern that fluid from the boxes can get into the surface water or ground water and, through runoff, go into nearby creeks and streams. I have attached two photos of dead boxes taken in February 2014 in Craven County and Jones County as Exhibits 8 and 9 respectively.

31. The trucks carrying mortalities to the rendering plant also leak. There is a rendering plant run by Valley Proteins, Inc., in Rose Hill, Duplin County.

32. I am also concerned about the impacts of the disposal of mortalities through burial, both improper burials and, also, burial that is technically in compliance with state rules but can contaminate ground water. This concern has been heightened by the recent spread in North Carolina of porcine epidemic diarrhea (PED). Swine CAFOs in Eastern North Carolina are located on low lying coastal plain with sandy soil, often at or near the flood plain and in proximity to wetlands. We have observed little regulation or oversight of how close burials are to state waters, the depth of the burial site, or how long the animals are left uncovered. The water table in this area of the state is high and

there isn't much distance before a pit reaches groundwater. I have seen hogs buried in holes that are filled with ground water. Two photographs that I took of buried hogs are attached as Exhibits 10, 11.

33. With more than 2,000 swine facilities in Eastern North Carolina, the impact on the water is significant.

34. At swine CAFOs, as the animals defecate, the waste either falls through slats in the floor or are scraped off into a "lagoon" which is an open cesspool of feces and urine. The lagoons start to fill up. To my knowledge, only 14 lagoons in North Carolina have a man made liner. The rest of them are primarily clay. These lagoons are sources of leaking into groundwater. The majority of the lagoons in Eastern North Carolina are more than 15 years old and susceptible to cracks, which increase leakage.

35. Once the waste has separated and the solid waste has settled in the lagoons, the process is to pump the liquid waste through a hose and land applicate through several different types of sprayers in the general area of the facility. Some portion of the liquid is channeled by drain tiles and ditches and ultimately makes its way to waters of the state.

36. The sprayers atomize the particles, which are airborne and capable of being transported for miles, depending on wind conditions. I have smelled swine manure on streets, passing by in my car, and have felt the mist coming on to my vehicle and on my skin.

37. The proximity of sprayfields to people's homes impacts water and air quality, and it also adversely affects the quality of life for neighbors, who are no longer able to sit on their back porch with a glass of sweet tea and enjoy their own property. The smell of hog feces and urine drives them back inside. People also experience the stress of being in an area where there is so much impact from a neighboring facility, which can divide the community. In some cases, part of community is connected to hog raising – as operators or employees, and another part is feeling the impacts and is opposed to it.

38. Swine are also moved at different stages of life. Most of the growers in North Carolina contract with an integrator. The integrator owns the animals and contracts with a grower for services during a set period – for example, a facility might be farrow to wean or wean to finish. They are generally moved between facilities or to the slaughterhouse in open tractor trailers. I have seen these trucks traveling through small communities, and out on the open road. The hogs defecate in the trucks, which then leak hog waste, particularly if it is raining. In addition, the transportation of hogs in open trucks creates a risk for the spread of disease. This is another layer of impact to the nearby communities.

39. I have participated in water monitoring on Stocking Head Creek, on a 3 ½ mile stretch of water with more than 30 CAFOs, as well as grazing cattle affecting the creek. The creek originates in the middle of a sprayfield. I have been monitoring that creek for a number of years and water testing reveals high levels of contaminants. CAFOs are the major contributors to contamination on this Creek. To my knowledge, there is one other source upstream – a septic tank pumping business. which has an area where human waste is applied. I have attached five monitoring reports from water testing in Duplin County, which show high bacterial and nutrient levels that are consistent with contamination from swine waste into waters. See Exhibits 12, 13, 14, 15 and 16. I have also attached "Stocking Head Creek Fecal Coliform Bacteria Investigation," a report submitted to Waterkeeper Alliance on January 18, 2014 by Michael A. Mallen, Ph.D, Center for Marine Sciences, University of North Carolina Wilmington as Exhibit 17.

40. The areas with high concentrations of swine CAFOs, such as portions of Duplin County, are disproportionately communities of color and low income communities and, historically and today, have lacked political and financial clout. This is one of the biggest concerns related to the impacts of the swine industry in Eastern North Carolina – local communities don't have enough clout to influence what they are exposed to, and it is also more difficult for these communities to get the political

accountability required to ensure attention from state officials charged with setting and enforcing permit conditions.

Inadequate Protection From Harm

41. The risks and harms associated with swine CAFOs are widespread, and from the perspective of both the impact on water and the impact on community members, more generally, these harms are exacerbated by the co mingling of swine, poultry and cattle.

42. As a Riverkeeper, I've seen manure spraying into ditches, gullies on sprayfields conveying waste to waterbodies, spraying during inclement weather, wind blowing manure mist onto neighboring properties, strong odors, leaking dead boxes, hogs buried in holes filled with water, and many other practices that adversely affect water quality, air quality, health and the quality of life. Enforcement mechanisms available under state and federal environmental law are inadequate to protect individuals, the impacted communities, and the waterways from harm.

43. North Carolina's Department of Environment and Natural Resources (DENR) has known about the adverse impact of swine CAFOs on communities in Eastern North Carolina for years, at least since I became the Lower Neuse Riverkeeper. I have raised these issues as to specific problems on particular facilities and more generally.

44. Over the years, numerous issues/formal complaints have been provided to state agencies (NCDENR, DWR, Dept. of Agriculture) which I, and others working with me, have documented from our ground and aerial monitoring. These include alleged illegal application of waste, discharges into water bodies, improper burial of dead swine carcasses, improper location of burial pits, issues with Dead Boxes and the long term storage of dead swine carcasses. I have also been involved with situations where Notice of Intent (NOI) documents have been filed as a result of sampling results acquired from a specific swine facility.

45. The avenues available to address violations of the law in North Carolina are not effective mechanisms for ensuring that swine CAFOs don't have an affect on

water quality, air quality, property value, quality of life, or other adverse impacts. Riverkeepers and community members can use the legal process and bring actions to enforce the Clean Water Act, which we have done and will continue to do. Waterkeeper Alliance has initiated a number of Clean Water enforcement actions in the last few years. But Clean Water Act citizen suits are expensive and time consuming, and there are significant procedural obstacles to bringing a case. The availability of legal avenues does not prevent adverse impacts on communities.

46. If there are issues of imminent concern where there has been a clear violation of a rule, like dead boxes being exposed for a couple of days or a sprayer being sprayed into a water body, then I have contacted the appropriate state agency – for example, the DENR or the Division of Water Resources (DWR) and asked them to respond. On occasion, for example, where we report that we see waste flowing directly in a water body, they have responded in a timely way. With budget cuts at DENR, there is additional reason to be concerned that inspections and responses may not be as timely in the future.

47. Even with imminent problems, DENR doesn't respond if the report is made on a weekend or after hours (5:00 PM). In general, on occasion when issues have been witnessed in late day or on weekend when the DENR (DWR) offices are not open, the time frame for response can be several days, thereby allowing for the alleged issue to have passed with no opportunity for investigation by the state agencies.

48. Even in the past, DENR has not addressed the problem, and there is a lack of appropriate enforcement. This would include specific complaints in reference to illegal spraying of swine waste onto a public road and/or into a public right of way ditch along a public road, spraying during a precipitation event and/or over saturation of a spray field. In the case of reported alleged illegal burial of dead swine carcasses, the enforcement action by DENR (DWR) was a simple Notice of Warning.

49. The sampling we've done demonstrates that the impacts of swine CAFOs on water are not limited to a handful of bad actors or a few incidents. We see ongoing high levels of nutrients and bacteria at multiple sites.

50. With more than 2,000 facilities, there are also accidents, which also have an impact. Facilities might turn the wrong valve or otherwise make mistakes that lead to overspreading of waste or other problems.

51. Even if waste management plans at swine CAFOs are followed, these plans don't guarantee that there won't be pollution or impacts on communities, because of the inherent nature of the process. Lagoons lined with farmer clay leak. Open cesspools of feces and urine have odor. Spraying liquid waste to an open field has odor. Particles sprayed from sprayers drift in the wind, taking with it the potential for the spread of bacteria and other contaminants. Ditches and tiles channel waste to waterways. Weather can be unpredictable and weather influences how waste is conveyed off the property. The lagoon and sprayfield system is not a closed system, such as you might find in a wastewater treatment plant, and it is difficult to control all of the variables. Current permit conditions are inadequate to prevent harm and to protect the health of people living, working, and going to school in proximity to swine facilities.

***

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in New Bern, North Carolina on August 27, 2014

[redacted]

Exhibit 1

Education

- **BS Geoenvironmental Science, December 2001, Shippensburg University, Shippensburg, PA**
    - Major course work: Water Resource Regulations, Wetland Restoration, Water Quality Monitoring, Field Techniques, Environmental Law, Soil Science, Atmospheric Studies, Geology, Biogeography, Geology, Hydrology, Remote Sensing, Environmental Land Use Planning
    - Twenty-two (22) additional credit hour emphasis in Biology/Chemistry
    - Geographic Information System (GIS) Certificate
    - Internship: Chesapeake Bay Foundation, Harrisburg, PA, 2001.

- **Graduate, School of Conservation, 1996, Professional Career Development Institute, Atlanta, GA**
    - Professional Forestry and Wildlife Conservation Program

- **AA General Studies, 1991, Hagerstown Community College, Hagerstown, MD**
    - Biology/Science focus

Related Career Experience

- **WATERKEEPER® Alliance**, **New York, NY**
  May 2012 – present
  North Carolina Concentrated Animal Feeding Operation (CAFO): Work with eight (8) Riverkeeper programs throughout North Carolina to help develop, implement and execute their specific efforts to advocate for better reforms and activities by the CAFO industry (Swine, Poultry, Cattle). The focus continues to be to challenge the CAFO industry by use of the Clean Water Act, as well as challenging state and federal rules governing the CAFO operations. Work with other organizations, agencies, communities and individuals to help educate the public to bring the negative impacts from these operations to light. Work directly with Waterkeeper Alliance attorneys, as well as outside legal counsel, and also work on the legislative activities as they impact the governing of the CAFO industry.
- **WATERKEEPER® Alliance**, **New York, NY**
  November 2011 – May 2012
  Contractor/Eastern North Carolina Coordinator: Focus on challenging the Concentrated Animal Feeding Operation (CAFO) industry, specifically targeting swine and poultry, through gathering Clean Water Act violation evidence, challenging state and federal rules governing the CAFO operations, while educating the public to the health concerns the CAFOs place on our environment as well as the human health concerns. Specific target area is the Cape Fear River basin. Also act as the Coordinator for the efforts of five (5) Riverkeeper programs in eastern North Carolina, monitoring the activities to assure consistency and accuracy of data being collected and also legal and legislative activities.

- **Neuse RIVERKEEPER® Foundation, New Bern, NC**
  October 2002 – November 2011
  Lower Neuse **RIVERKEEPER®**: Advocate for the health of the Neuse River watershed through education, outreach and enforcement. Directly responsible for development, fundraising and outreach. Focus on challenging the Concentrated Animal Feeding Operation (CAFO) industry, specifically targeting swine and poultry.

- **Helicopter Applicators, Inc., Gettysburg, PA**
  Field Operations: on-site aerial monitoring of forest fires using remote sensing equipment mounted on a helicopter and production of maps used to fight the fires.

- **Environmental Management Systems, Rockville, MD**
  Field Technician: recovery, packing and transport of hazardous chemicals from industrial sites for disposal.

- **EMSI, Inc., Frederick, MD**
  Field Technician: monitored/sampled groundwater contamination of gas stations; installation and maintenance of Soil Vapor Extraction.

Additional Experience

- 23 years of manufacturing and warehouse management.
- 5 years laboratory research and development and wastewater monitoring experience
- 4 years field experience in the environmental industry (asbestos monitoring/abatement, riparian buffer construction, stream monitoring, submerged aquatic vegetation (SAV) planting, oyster restoration).
- Board of Directors, "Discovery Station at Hagerstown", Hagerstown, MD
- Washington County Solid Waste Advisory Committee, Hagerstown, MD
- Chesapeake Bay Foundation "Speakers' Bureau", Annapolis, MD
- Conducted a Watershed Workshop for the Cumberland River Compact in Nashville, TN, representing the Chesapeake Bay Foundation
- Oyster Recovery Partnership "Oyster Transplanting" volunteer, Horn Point, MD
- PADI Certified SCUBA Diver (1978)
- Pamlico Community College Science Advisory Committee, Oriental, NC
- Board of Directors, Rural Empowerment Association for Community Health (REACH), Warsaw, NC
- Past Board President, REACH, Warsaw, NC
- Licensed Member: ***WATERKEEPER®*** Alliance
- Member: Albemarle-Pamlico National Estuary Program (APNEP) "Science and Technology Committee
- Member: Herring Alliance
- Member: Waterkeepers Carolina
- Member: PlanIt East "Military Growth Task Force" Committee, "Environmental Impact Subgroup"

Research Experience

- Pennsylvania Geographic Society (PGS) Project Presentation; ***"Sanitary Landfills: An Historic, Technical, Operational and Environmental Perspective".*** Paper published in the annual PGS newsletter, 2002
- Shippensburg University Grant (UG 2001 #1748), ***"Heischman's Mill Shad Restoration Project: Fish Ecology"***

Exhibit 2

Exhibit 3

Exhibit 4

Exhibit 5

Exhibit 6

Exhibit 7

Exhibit 8


JOHN DEERE
4030

Exhibit 9


CAUTION

Exhibit 10

Exhibit 11

Exhibit 12

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(252) 473-5702

NCDENR: DWQ CERTIFICATE #94. DLS CERTIFICATE #37729

Cape Fear River Watch
617 Surry Street
Wilmington NC 28401
Attention: Kemp Burdette

Date of Report: Feb 04, 2014
Customer PO #:
Report #: 2014-00671
Report to: Kemp Burdette
Project ID:

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01660	**Site:** B-003	1/16/2014 9:35 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	< 0.2 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.9 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.05 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	24.8 mg/L	01/28/2014
Fecal Coliform	SM 9222D MF	11400 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.03 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	9.31 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	9.28 mg/L	01/27/2014

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01661	**Site:** B-004	1/16/2014 9:56 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.4 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	< 0.5 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.09 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	0.08 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	6800 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.04 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	12.1 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	12.1 mg/L	01/27/2014

Exhibit 13

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(252) 473-5702

NCDENR: DWQ CERTIFICATE #94, DLS CERTIFICATE #37729

Cape Fear River Watch
617 Surry Street
Wilmington NC 28401
Attention: Kemp Burdette

Date of Report: Feb 04, 2014
Customer PO #:
Report #: 2014-00671
Report to: Kemp Burdette
Project ID:

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01662	**Site:** SHC-001	1/16/2014 9:44 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.6 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	< 0.5 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.05 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	< 0.04 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	6200 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	< 0.02 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	25.1 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	25.1 mg/L	01/27/2014

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01663	**Site:** SFH-001	1/16/2014 11:35 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.8 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.7 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.11 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	< 0.04 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	82000 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.07 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	9.95 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	9.88 mg/L	01/27/2014

Exhibit 14

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NCDENR: DWQ CERTIFICATE #94. DLS CERTIFICATE #37729

Cape Fear River Watch
617 Surry Street
Wilmington NC 28401
Attention: Kemp Burdette

Date of Report: Feb 04, 2014
Customer PO #:
Report #: 2014-00671
Report to: Kemp Burdette
Project ID:

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01664	**Site:** SFH-002	1/16/2014 11:20 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.3 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	1.6 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.16 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	0.05 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	16000 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.11 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	8.94 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	8.83 mg/L	01/27/2014

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01665	**Site:** SFH-003	1/16/2014 11:05 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	< 0.2 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	< 0.5 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	<0.02 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	< 0.04 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	10200 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	< 0.02 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	19.9 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	19.9 mg/L	01/27/2014

Exhibit 15

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NCDENR: DWQ CERTIFICATE #94, DLS CERTIFICATE #37729

Cape Fear River Watch
617 Surry Street
Wilmington NC 28401
Attention: Kemp Burdette

Date of Report: Feb 04, 2014
Customer PO #:
Report #: 2014-00671
Report to: Kemp Burdette
Project ID:

Lab ID	Sample ID:	Collect Date/Time		Matrix	Sampled by
14-01666	**Site:** SFH-004	1/16/2014	10:15 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.3 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	< 0.5 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.06 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	< 0.04 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	30000 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.04 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	13.4 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	13.4 mg/L	01/27/2014

Lab ID	Sample ID:	Collect Date/Time		Matrix	Sampled by
14-01667	**Site:** SDCR-001	1/16/2014	11:50 AM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.3 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.9 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.12 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	< 0.04 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	22000 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.08 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	7.99 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	7.91 mg/L	01/27/2014

Exhibit 16

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(252) 473-5702

NCDENR: DWQ CERTIFICATE #94. DLS CERTIFICATE #37729

Cape Fear River Watch
617 Surry Street
Wilmington NC 28401
Attention: Kemp Burdette

Date of Report: Feb 04, 2014
Customer PO #:
Report #: 2014-00671
Report to: Kemp Burdette
Project ID:

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
14-01668	**Site:** SHCR-001	1/16/2014 12:05 PM	Water	Larry Baldwin

Test	Method	Results	Date Analyzed
Ammonia Nitrogen	EPA 350.1	0.4 mg/L	01/31/2014
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.9 mg/L	01/27/2014
Orthophosphate	SM 4500 P E	0.11 mg/L	01/17/2014
Total Phosphorus	SM 4500 P F	< 0.04 mg/L	01/27/2014
Fecal Coliform	SM 9222D MF	22000 Colonies/100mL	01/16/2014
Nitrate Nitrogen (Calc)			
Nitrite Nitrogen	EPA 353.2	0.05 mg/L	01/17/2014
Nitrate+Nitrite-Nitrogen	EPA 353.2	8.88 mg/L	01/23/2014
Nitrate Nitrogen	Subtraction Method	8.83 mg/L	01/27/2014

Comment:

Reviewed by: Jim Pierce / Mavdla Olejarz

Exhibit 17

Stocking Head Creek Fecal Coliform Bacteria Investigation

Submitted to Waterkeeper Alliance

January 28, 2014

Michael A. Mallin, Ph.D.
Center for Marine Sciences
University of North Carolina Wilmington
Wilmington, N.C. 28409
Phone: 910 962-2358
Email: mallinm@uncw.edu

Introduction

Stocking Head Creek is a 2nd order stream located in Duplin County, in the Northeast Cape Fear River basin on the Coastal Plain of North Carolina. It lies within subbasin 03-06-22, and is classified as C Sw waters by North Carolina Division of Water Resources. This stream receives potentially polluted inputs from multiple swine and poultry CAFOs in the basin, as well as from grazing cattle. Thus, its potential for degraded water quality is high. As this stream consists of public waters, it was of interest to investigate whether or not these waters are impaired based on North Carolina Department of Environment and Natural Resources (NCDENR) fecal coliform bacteria standards.

Methodology

To obtain a full perspective of the stream's physical and chemical qualities a suite of parameters was sampled. The University of North Carolina Wilmington Center for Marine Science Aquatic Ecology Laboratory is State-certified for field measurements, and the following measurements were made on-site using YSI field meters calibrated and checked according to standard procedures: water temperature, pH, dissolved oxygen, turbidity and specific conductance. Also on-site, samples were collected according to standard procedures for nutrients (ammonium, nitrate, total nitrogen, orthophosphate, total phosphorus), chlorophyll *a*, biochemical oxygen demand (BOD5), fecal coliform bacteria and total suspended solids. The University of North Carolina Wilmington Center for Marine Science Aquatic Ecology Laboratory is State-certified for chlorophyll *a* analysis. Samples (except for chlorophyll *a*) were kept on-ice and returned to a state-certified laboratory for subsequent analysis, within proper holding times. Chain of custody records were maintained. We note that NCDENR has freshwater numeric standards for dissolved oxygen, turbidity, fecal coliform bacteria, and chlorophyll *a*.

Sample Frequency

The overall approach was to conduct intense sampling (five sample trips) during two different 30-day periods, one in mid-summer and one in fall. This was planned to abide by NCDNER's protocol for fecal coliform sampling.
The North Carolina protocol states that fecal coliform counts shall not exceed a geometric mean of 200 CFU/100 mL based on at least five consecutive samples during any 30 day period, nor exceed 400 CFU/100 mL in more than 20% of the samples examined during such period.

Sampling of Stocking Head Creek occurred during both dry and wet periods. Following cessation of all sampling, rainfall data were obtained from the NC CRONOS data set, using station #319026 Wallace, Latitude 34.72, Longitude 77.97778, in Duplin County. Rainfall amount was computed for the day of sampling, the day of sampling plus the previous 24-hr period, and the day of sampling plus the previous 48-hr period.

Sample Sites (see site map)

There were seven stations sampled during both 30-day periods (see map – Fig. 1).

Figure 1. Map of Stocking Head Creek showing sampling locations.

All sites were sampled from bridges on public right-of-ways. Appendix A shows photographs of the sampling sites from different perspectives.

Data Analyses

Sample data were entered into Excel spreadsheets and summary statistics were performed for each period (means, standard deviations, medians, minimum, maximum, and geometric means (for fecal coliform analysis). This report presents only fecal coliform bacteria data; the other parameters will be presented in a subsequent more comprehensive report.

Results and Discussion of 2013 Fecal Coliform Bacteria Sampling

Fecal coliform bacteria: The State of North Carolina uses fecal coliform bacteria counts as a proxy for potentially-pathogenic bacteria in fresh water bodies. Potential sources include human sewage, wildlife, and livestock including cattle, swine and poultry. The NC protocol for sampling and means for determining fecal impairment of a water body are explained above under “sampling frequency”.

Table 1. Fecal coliform bacterial counts for Stocking Head Creek, summer and fall 2013, data are as colony-forming units (CFU)/100 mL.

Stocking Head Creek fecal coliform bacteria sampling stations 2013.

	1	2	3	4	5	6	7	geomean
Date	TR-SDCR	SHC-GDR	SHC-CSR	SHC-SDCR	SHC-SHCR	SHC-50	SHC-PBR	
7/29/2013	1,091	728	819	1,637	2,400	91	55	536
8/1/2013	455	2,400	546	910	12,000	109	172	740
8/13/2013	6,000	1,000	1,728	728	1,182	91	364	840
8/20/2013	819	1,460	2,400	1,000	1,460	1,360	637	1,202
8/27/2013	44,000	546	3,300	3,800	26,000	370	4,000	3,807
9/16/2013	60,000	330	819	8,000	23,000	109	270	1,895
9/18/2013	16,000	910	2,700	819	3,700	109	819	1,402
9/24/2013	12,000	3,000	5,000	2,700	60,000	172	430	2,994
10/8/2013	60,000	2,500	1,090	2,700	2,600	748	586	2,432
10/10/2013	54,000	1,730	640	1,550	2,800	380	172	1,498
geomean	9,126	1,184	1,470	1,772	5,863	220	391	

Fecal coliform counts for Stocking Head Creek in July and August 2013 were in general very high and place this creek clearly as one impaired per the State of NC definition. For the summer 2013 sampling period, the upper five stations exceeded 400 CFU/100 ml 100% of the time sampled (Table 1; Fig. 2), and the geometric means for all seven stations exceeded 200 CFU/10 mL for five samples in 30 days.

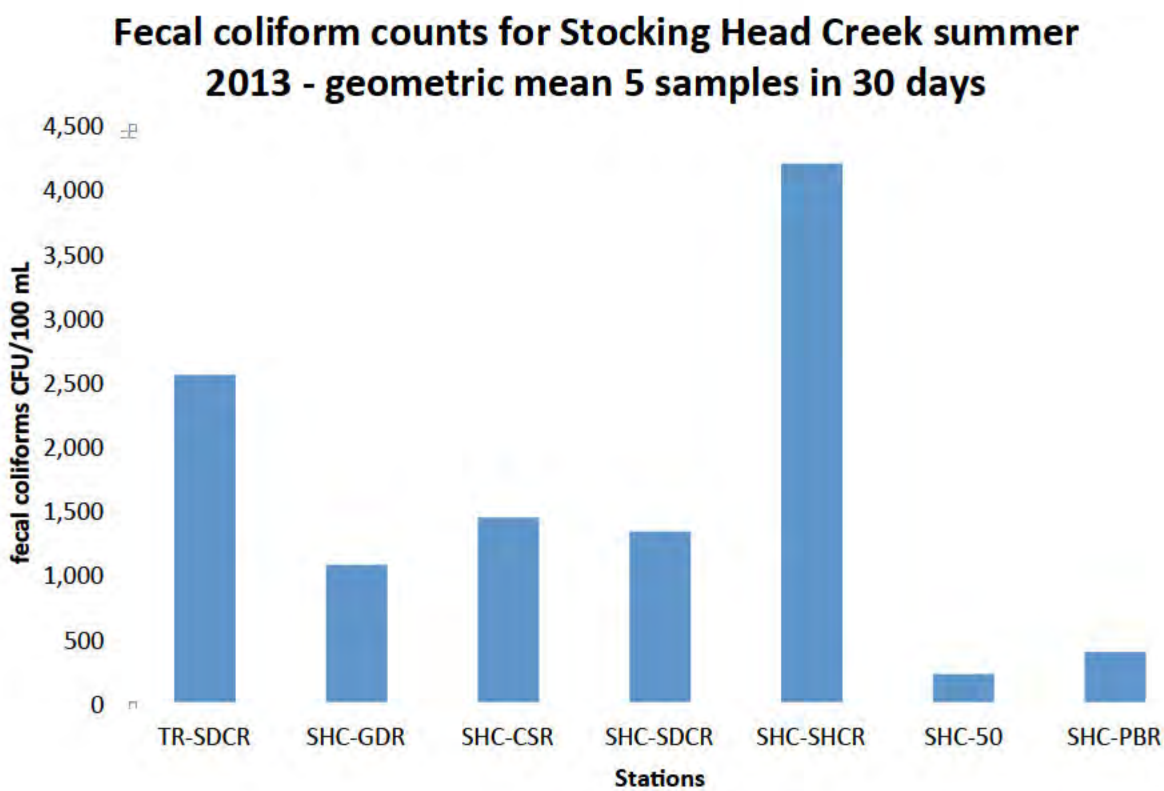


Figure 2. Fecal coliform counts as geometric mean for Stocking Head Creek July and August 2013; compare with NC standard of 200 CFU/100 mL.

Fecal coliform counts for Stocking Head Creek in September and October 2013 were in general very high, in some cases even higher than in summer, and place this creek clearly as one impaired per the State of NC definition. For the fall 2013 sampling period, the upper five stations exceeded 400 CFU/100 ml 96% of the time sampled (Table 1; Fig. 3), and the geometric means for six of the seven stations exceeded 200 CFU/10 mL for five samples in 30 days.

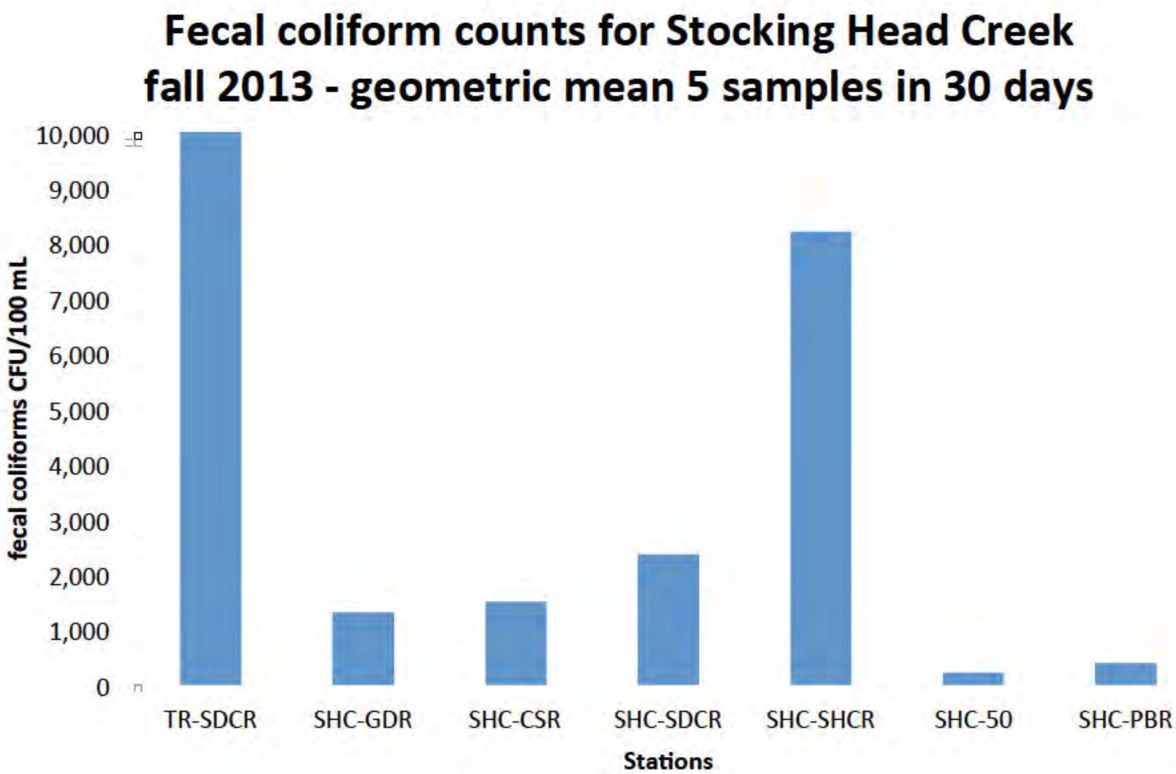


Figure 3. Fecal coliform counts as geometric mean for Stocking Head Creek September and October 2013; compare with NC standard of 200 CFU/100 mL. Note the actual geometric mean for TR-SDCR is 32,689 CFU/100 mL (way off page).

Lack of Rainfall Influence: Measurable rainfall occurred either on the day of sampling or within the 48 hr preceding the sample day on five sampling occasions. They were August 1 and 13, September 24, and October 8 and 10. For all non-rain sample dates and stations the fecal coliform geometric mean was 1,455 CFU/100 mL, and counts exceeded 200 CFU/100 mL 31 of 35 samples for a rate of 89% standard exceedence. For all rain periods and stations combined the fecal coliform geometric mean was 1,467 CFU/100 mL, and counts exceeded 200 CFU/10 mL on 30 of 35 samples for a rate of 86% exceedence of standard. Thus, fecal coliform pollution of Stocking Head Creek is not rain dependent; rather it is a chronic condition.

Conclusions: Fecal Coliform Bacteria

Seven stations in Stocking Head Creek, Duplin County, North Carolina, were sampled on five occasions within 30 days in both summer and fall 2013. The data indicates that Stocking Head Creek is highly polluted by fecal bacteria, by both measures of the NC criteria. The upper five stations exceeded 400 CFU/100 ml 96-100% of the time sampled, and six of seven stations exceeded a geometric mean of 200 CFU/10 mL for five samples in both 30 day periods. Elevated fecal coliform counts occurred during both wet and dry periods; this creek is chronically polluted by fecal bacteria.

Appendix A. Photographs of the sampled sites (in rough descending order from headwaters to lower creek):

SHC-GDR (Stocking Head Creek at Graham Dobson Road): N 34.91197 W 77.94507; Collects the uppermost branch of Stocking Head Creek (Plates 1A, 1B), upstream CAFOs and sprayfields present.

Plates 1A (left) – Uppermost station on Graham Dobson Rd., 1B (right) SHC-GDR is located at the first dip along Graham Dobson Road.

SHC-CSR (Stocking Head Creek and Cool Springs Road): N34.90279, W 77.94440; Collects one upper branch of Stocking Head Creek (Plates 2A, 2B), no immediately adjoining CAFOs or sprayfields, but there are CAFOs nearer the creek upstream (see Fig. 1).

Plates 2A (left) – Cool Springs Road site from air, 2B (right) Creek at SHC-CSR.

TR-SDCR (un-named tributary entering Stocking Head Creek at South Dobson Chapel Road): N 34.88878   W 77.94453; Site was originally hoped to serve as a field control as influence of CAFOs appeared to be low in this upper area of the tributary on first visit; however on subsequent visits evidence of lagoon spraying was present as were cattle (Plates 3A, 3B).

Plates 3A (left) – Tributary off South Dobson Chapel Rd., Station TR-SDCR; 3B (right) bend on South Dobson Chapel Rd. where TR-SDCR is located.

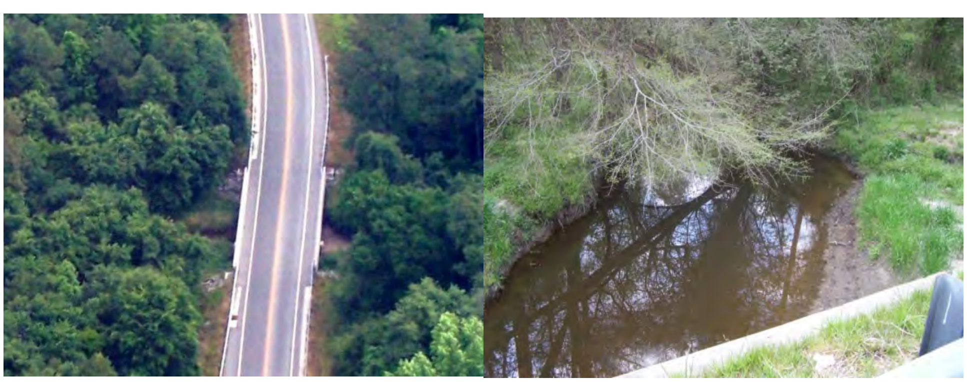
SHC-SDCR (Stocking Head Creek and South Dobson Chapel Rd. – Plates 4A and 4B): N 34.89796   W 77.93628; Numerous CAFO, sprayfields, and grazing cattle near creek

Plates 4A (left) and 4B (right) Station SHC-SDCR, downstream and upstream.

SHC-SHCR (Stocking Head Creek at Stocking Head Road - Plates 5A, 5B): N 34.88710 W 77.91124; CAFO sprayfields immediately adjoining creek.

Plates 5A (left) Sampling site from bridge on Stocking Head Rd., with nearby CAFO shown; 5B (right) Station SHC-SHCR.

SHC-50 (Stocking Head Creek at SR 50 – Plates 6A, 6B): N 34.87950 W 77.89438; Site adjoins a large wetland area which is hydrologically connected to creek.



Plates 6A (left) Sampling site off bridge on Highway 50, 6B (right) Station SHC-50.

SHC-PBR (Stocking Head Creek at Pasture Branch Road – Plates 7A, 7B): 34.87043 W 77.86539; This is a downstream reach with no evident CAFOs immediately nearby. There is an adjoining forested wetland that supplies flow to the stream here.

Plates 7A (left) Sampling site off bridge on Pasture Branch Rd., 7B (right) Station SHC-PBR.

Exhibit 7

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my personal knowledge unless otherwise indicated.

Background

2. I live at [redacted] with my wife, [redacted] We are both [redacted] and have lived at this address for forty years. We raised our three children in this home, although they have since moved out. I am African American.

3. I retired from my job as a schoolteacher ten years ago. I now devote much of my time to volunteer work helping the elderly, and I go to church regularly.

4. I grew up in a house on [redacted]. In addition to my current residence, I still own this home, as well as another property on [redacted].

Experience Living Near Hog Facilities

5. There are several hog facilities near my home, including a very large facility on Hc Powers Road less than one mile away. See Exhibit 1. Living near these facilities has negatively impacted me and my family in several ways.

6. For many years I was able to rely on a deep well on my property to supply water for my home. During the 1999 hurricane season, nearby lagoons containing hog waste broke and flooded the area. My well was contaminated with hog waste, which made the well water taste and smell different than it had before. Because I could no longer use the water from my well, I had to have my house connected to the county water system. I paid approximately $1,000 to have my deep well drilled, but after that initial investment it had only cost me an additional $5 or so

per month in electricity to operate the well. Now that I use county water, I have to pay $26 every month for water.

7. The stench from the hog facilities comes and goes, depending on whether they are spraying at the spray fields and the weather. My family and I can no longer enjoy outdoor activities because of the smell and the flies that the spray fields attract. I used to host an outdoor cookout every Fourth of July, but because of the nearby hog facilities I had to move the cookout to a rented space at a separate location.

8. My wife and I used to hang our clothes out to dry outside, but the smell from the hog facilities has forced us to switch to using a dryer. We used to open up our windows to let in fresh air, but now we have to keep our windows shut to keep the stench from getting into our house.

9. Nutrients from the spray fields make the grass at my [redacted] property grow very fast, so I have to mow my lawn one or two times every week. This is roughly twice as often as before the spray fields arrived. This is a real burden for me. If I hired someone to mow the lawn for me, it would cost about 100 dollars every time.

10. My wife is very sensitive to the chemicals the hog facilities shoot into the air. Before she underwent a [redacted] four years ago, she was on dialysis for five years, which forced her to spend a lot of time at home. She hates having the air conditioner on, so not being able to open up the windows or go out into the yard has been very unpleasant for her.

11. My son, who moved out in 2000, suffered from frequen[redacted] infections, [redacted], and [redacted] when he lived here, and I wonder if pollution from the hog facilities contributed to his health problems.

<u>Impact of Nearby Hog Facilities on my Other Properties</u>

12. My property at [redacted] is located approximately 100 yards from the nearest hog facility. I have been trying to sell this property since 2004 without success, as prospective buyers complain of the stench from the hog facilities. I have also tried to rent sites on the property without success. People come to see the property but are not interested in renting after they visit because of the smell. I believe that hog facilities have devalued the property and kept me from taking advantage of this source of income.

13. My property at [redacted] is also located near hog facilities, and it is less than [redacted] from the Valley Proteins rendering plant on Yellow Cut Road. The rendering plant is where dead hogs and chickens are processed to make proteins, and it sprays the liquefied guts and waste on nearby spray fields just like the hog facilities. I grow grapes on my 15 acres of land at [redacted] and visit the property frequently. I often smell the stench from the rendering plant and hog facilities when I am at my [redacted] property.

<u>My Knowledge of Hog Farming in North Carolina</u>

14. I remember what it was like before large hog facilities came to my area. I grew up raising hogs, five or six at a time, and we never had the problems with waste that you see with larger facilities.

15. Because of the ways in which hog facilities have affected me and my family, I did some research online to learn more about them. It is my understanding that there are 522 hog facilities in Duplin County, each housing between up to 12,000 animals at a time. Depending on the age of the hogs, each hog produces over 190 gallons of manure over the course of its stay at a hog facility. Having several thousand animals in a single facility leads to too much waste in a concentrated area.

16. It is my understanding that hog facilities emit over 300 chemicals into the air. These include ammonia, other nitrates, sulfites, and toxic chemicals that can break down the immune system and cause illness. It is my understanding that air pollution from hog facilities can lead to asthmatic symptoms, skin irritation, and eye irritation.

17. It is my understanding that hog facility operators are supposed to spray on spray fields only under certain conditions, but I have observed spraying at nearby spray fields at all hours, regardless of the weather. Hog facilities produce a lot of waste, and they need to be properly regulated.

18. I have not tried to complain to county or state authorities about the hog facilities. The owners of the hog facilities are the richest people in the county. It is my understanding that Wendell Murphy used his influence to get the laws changed in Raleigh, and that allowed him and others to build all the hog facilities here in Duplin County. I have not complained because I think that state and county government will not do anything about the problem.

19. I think that the way hog facilities affect nearby communities is a civil rights issue. Just look at a map and you can see that the facilities are located in black communities. Hog facilities should not be built in areas where people live.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Walker, North Carolina on 8-27, 2014

[redacted]

[redacted]


Exhibit 2
Legend
(b) (6) Privacy
A Hog Facility
E Hog Facility
D Hog Facility
F Hog Facility
B Hog Facility
C Hog Facility
[redacted]
Google earth
© 2014 Google
N
3000 ft

Exhibit 8

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted] (See Attached Map). My house is built on land that my family owns. I have lived in my current home for half of my life. I was born in [redacted] and lived in my grandparent's home which is 1500 yards from where I currently live. At the age of eighteen, I joined the military. In the 1980's I returned to Duplin County and moved into my current home.

3. I currently live alone. My wife passed away in 2005. My daughter, [redacted] s now [redacted] ld and lives in Greensboro, North Carolina. We had two family dogs, but they are now both deceased.

4. I am retired but I used to work for General Electric in Wilmington, North Carolina. I would commute from Wallace to Wilmington every day for work. I retired from GE due to disability. I have had two neck, two back, and three knee operations. These are the result of playing football.

5. When my family moved to our current property there were no hog farms. It was in the late 1980's and 1990's that hog farms started to pop up. In fact, one of the hog farms is on land that my great-great-grandfather used to own. He sold the land and it was a big mistake. Today there are at least three hog facilities within a two mile radius of my home.

6. Other family members are located next to the hog farms. My cousins live directly in front of a hog farm. They live closer to the hog facility than I do. When they spray, the waste goes directly on them.

Experience Living Next to a Hog Facility

7. Living near a hog farm means that you are overwhelmed with flies. Any time of the day there is a tremendous stench. My wife used to hang clothes to dry on a clothesline but we had to stop because the smell would get in the clothes. I can't cookout or sit outside and enjoy my porch because the smell from the sprayers is so unbearable. And I can't open my windows. Even if they aren't spraying I don't open my windows because I don't know when the wind is going to change direction. Hog stench is different; it burns your nostrils and causes your eyes to water. You can't seem to catch your breath when it smells. You know you are in Duplin County when you smell the hog waste. There is no fresh air unless it rains and then it comes right back because each farm sprays several times a week.

8. I used to have my own pump that would provide us with well-water but once the hog farms came in the water became contaminated. I hooked up to the town water about 20 years ago. I did the work myself to save money. By the time I was done, it ended up costing a little less than $500. Now I have to pay for the county water to make sure the water I am drinking is safe.

9. I love to hunt and fish but this is not something that I can do anymore. I haven't fished in over 20 years and I haven't hunted in approximately 10 years. I had to stop because the fish are contaminated from the water and I don't want to eat any wildlife that has been eating and drinking around hog farms.

10. I also enjoy riding my four-wheeler. However, the smell can get so bad that I can barely breathe. I have to try to go four-wheeling when they aren't spraying but sometimes I have to turn around after a couple of miles if they start spraying or the smell picks up.

11. I have seen a hog farm owner put dead hogs in the woods instead of in the dead-box. The reason they do that is because they don't want to increase their number of dead pigs. If they have too many pigs dying then I think that the farm could get shut down.

12. I am not the only family member that has been impacted by the hog farm. My daughter loves to be outside, but when she comes to visit she can't open the windows or sit outside to enjoy the air. I would love to be able to go out there

and take my granddaughter and grandson fishing, but that is not possible because I live next to a hog facility.

How the Community is Affected by the Hog Farms

13. Community members don't sit out and talk on their porch anymore. Especially old people, they like to sit out on their porch and socialize. That's what country people do. But because of the smell from the sprayers people don't keep in touch as well anymore.

14. The effect of hog farms is not just felt at my home. There is a hog farm next to Charity Middle School which is where my daughter attended school. There is also a hog facility 500 feet away from my church, at Peter's Tabernacle. Since the hog farm is so close to the church we can't have events outside. We used to grill every year at the church but that has stopped due to the smell from the hog farms.

Health Concerns From the Hog Facilities

15. I have frequent [redacted] infections and [redacted] problems that are triggered when I go outside. I have [redacted] and they are exacerbated by the smell.

16. My wife passed away from [redacted]. I can't say if this is from the hog farms, but I am sure it didn't help.

17. My cousins who live right next to the hog facility suffer from asthma. They also suffer from heart problems.

18. We had two dogs. They were kept outside in a pen. Both dogs passed away suddenly and without any apparent reason. There were no bites. We just found them dead in the pen. I think this is the result of the spraying from the hog farm.

<u>My Efforts to Change Hog Farm Practices in North Carolina</u>

19. In 1989 or 1990 I went to Raleigh to protest the hog farms in North Carolina.

20. I am also a part of the nuisance complaint with [redacted]

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in WAllAce, North Carolina on August 30, 2014.

Signed: [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1.5 miles

Source: Google Maps

Exhibit 9

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted] in [redacted] (See Attached Map.) I am [redacted] old. I have lived at this residence since I was born. The property is in my name. I do not work because I have a disability.

Experience Living Near the Hog Facilities

3. There are at least ten hog farms within two miles of where I live.

4. I remember when farmers used to raise hogs in the field. My mom and dad had plenty of hogs when I was growing up. My family had about 40 hogs. I remember being able to smell the hogs when I was near their pen or when I went out to feed them, but I couldn't smell them when I went outside the house, like I can with the large, industrial hog farms that moved in near my home.

5. I have told the hog farm owners near me about my concerns on many occasions, but it hasn't changed things.

6. I want them to clean up and to stop spraying waste where it gets into my yard and my water, and to make it not smell so bad.

7. When I found out that I could get my water tested for free by the state, I called and had it tested. This was several years ago. Within a week after my water was tested, the state told me that I couldn't drink or cook with it, and I couldn't let my pets drink the water. I don't recall the individual who did the testing, or the specific problems that were discovered, but I know I was told to discontinue using the water. After my water was tested, the same hog farmer near me found out about the results. I am not sure how he found out, but soon after the state tested my water and told me that it was unsafe to use, that farmer came back with their industry spokesperson and asked me a lot of questions as if they were trying to make it seem like I was out to get the hog farmer. This upset me a great deal. I think that the farmers were trying to intimidate me. They went behind my house and told me that the source of contamination came from my two month-old puppies. They also tried to make it seem like I had hogs on my land now, but I did not have any farm animals on my land. I felt like these men were trying to take advantage of me because I am a woman. They said that I did not know anything about farming, but I do know about farming because my family farmed.

8. The industry spokesperson asked me if I have ever thought about moving. I felt that they were telling me that if I didn't like the hog farms, then I

should move. I lived here before them, however, since 1943, and I have no intention of moving.

9. When I was growing up, in the forties, I never could have imagined that waste lagoons would be near people's churches or homes. That has all changed now. I attend Smith Chapel and we can smell the hog waste inside and outside the church. There's also a bad fly problem near the church, which I think is related to the hog farms.

10. I'd like to be able to relax outside of my home, but I can't sit on the porch due to the strong hog waste odor. Every morning I start out by seeing how strong the smell is outside, to see if I will be able to go outside. Whenever I have visitors, the length of their stay depends on how strong the smell is that day. There are always big flies associated with the smell.

11. Sometimes I need to hang my clothes outside to dry. When the farmer sprays the hog waste, however, I always have to rewash my clothes if I don't get the clothes in off the line soon enough. This is because the smell of the waste gets into my clothing if I leave it on the clothesline.

Health Concerns Regarding the Hog Facilities

12. When I smell the hog farms it makes me sick to my stomach and I throw up. Several years ago, I went to the doctor in Kinston because of my [redacted] and the doctor told me that I had a [redacted] He did not say what it was caused by, but I think living near all these hog farms made it worse.

13. When my grandson was young, from when he was one year old to eight years old, he had a bad allergic reaction to the hog waste smell. When he came to visit, he would have a [redacted] and a [redacted] and sometimes would gag at the smell. His [redacted] and [redacted] went away when he left my house and returned to his home, where it didn't smell like hog waste. He is [redacted] years old now.

14. My home is hooked up to county water now. We used to have well water until it was tested and found to be contaminated. It was tested out of Wilmington with the Division of Water Quality. After my well water was turned off due to the contamination, county water was not yet available at my house. I had to buy water at the store, or get water from other people who did not have contaminated water. Each time I did this I had to carry 10-15 lbs. of water. On top of all this, it was a financial hardship to purchase water. It wasn't in the budget then and it still isn't now. I had to buy water or find a way to get safe water for free for about a year. When a county water hook-up was accessible, I had to pay to hook up to it. The

fee was between $50 and $100 for that service. I still question if there could possibly be breaks in the line where hog farm runoff could enter the pipes. Because of this, I am still afraid to drink my water.

<u>My Efforts to Change Hog Farm Practices in North Carolina</u>

15. I have participated in legislative activities and vigils in Raleigh, North Carolina with [redacted] organization. This was in 2007.

16. I also attend meetings at [redacted] about the hog farms. I have attended meetings about the issue at my church as well. I have talked to others in my community about the issues caused by the hog facilities.

17. If there was one thing I could do to fix the problems created by hog farms, including the smells, the flies, and the water quality damage , it would be to bring back family farms. I don't want to put large farmers out of business—I just want them to be good neighbors.

18. Hog farming has a greater negative impact on Black families. From what I have seen and heard from talking to others who live in eastern North Carolina, and from my own personal experience, the hog facilities are always set up around Black families and Black communities.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Warsaw, North Carolina on September 02, 2014.

Signed [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 2 miles

Source: Google Maps

Exhibit 10

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted]n [redacted] (See Attached Map). I have lived in Duplin County for fifteen years. I live with family members, including [redacted] he home I live in is owned by my family. Before living here, I lived at [redacted]

3. I have never been involved in advocating against hog farms and how they have affected me until now.

Experience Living Next to the Hog Facility

4. The hog facility sprayfields are near our home. One is less than a quarter mile away. More are less than a mile away. Sometimes I see the hog farmers across the street. One of them sprays the manure. I don't speak to him.

5. Given how close my family lives to the hog facility, and the sprayfields in particular, many members of my family, myself included, have been exposed to the odor and harmful pollutants that come with raising animals in confinement.

6. Because my family lives so close to the hog farms, my family and I rarely cook out, we worry about hog waste spray getting on our cars, and we smell it when we sleep. Most of the time we smell it at night. For most all circumstances, we cook inside to avoid the smell of the hog facilities.

7. I have major concerns about these large hog farms. My primary concern is the residue left from the spraying. If the spraying didn't have such a major effect on my living condition, it wouldn't be as big of a problem. The spraying affects everyone. The hog farmers shoot the spray very high up and it lands on people's cars passing on the highway. It's very bothersome and people can see where it leaves residue on their cars. The spray lands on my aunt's car. I park my car on the side of the house where the spray doesn't land so it doesn't leave a residue on my car. My family and I can also see it on the windows of the house that my aunt rents. In addition, my family doesn't put anything on the side of the house or in the backyard because of the spray residue.

8. I am also concerned about the poor air quality that comes from the hog waste. The smell is so unpleasant and so strong that it's hard to breathe and it makes me sick to my stomach. I wish the hog farms weren't located so close to where people live. I know it isn't safe for my goddaughter or for kids who want to be outside. My goddaughter is one year old. She lives on (b) (6) Privacy [redacted] in

Teachey, North Carolina. We don't go outside when we are here, at my house, because I don't want her to get sick.

9. The second major concern is our water quality. My father complains about it and thinks is may not be safe to drink because of our close proximity to the hog farms.

10. I have aunts who live in Maryland that don't want to visit me because of the smell. If they do come to visit, they complain about the smell. I don't invite people to visit because the smell is embarrassing.

11. I find my living situation very difficult. When I come home from work I either stay inside or I go somewhere else, away from the hog farms. If it weren't for the hog farms and the bad conditions they bring about, I would spend more time outside. I used to spend a lot of time outside playing softball and volleyball. Because of the hog farms, however, I haven't spent time outside like I did in the past.

<u>How the Community is Affected by the Hog Farms</u>

12. Over the past couple of years I think the smell from the hog farms has gotten worse. We have also noticed that when the smell is very bad, we have a greater bug problem outside.

13. Everyone living on [redacted] is affected by the hog farming. Some people don't want to speak about it—they just deal with it. The

woman across the street complains about the hog farming, but she doesn't speak up about it.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Wallace, North Carolina on August 30, 2014

Signe[redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

Exhibit 11

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted] in [redacted] with family members, including [redacted] (wife), [redacted] (daughter), and [redacted] (daughter). I have lived at this location for about 12 years. (See attached map) I own my home.

3. The current home I live in is near a hog facility off of [redacted]

4. Before I moved to Wallace, I lived down the road from farmer Murphy's hog farm, at [redacted] I lived there with my mother and father when I was growing up and again for two years with my wife, [redacted] around 1989 or 1990.

5. My brother [redacted] and I own my parent's house together. My mother and father passed away and my brother stays there.

6. When I was ten years old, I helped Murphy on his farm. I cleaned out the hog trailers on the weekends. My brother and I started out doing this together. Back then, the farms were smaller. When I was 11 to 15 years old, I helped his daughter's husband with the hogs and the hog pens.

7. I served in the military for seven years. Other than the time that I was in the military, I have lived near a hog farm.

<u>Experience Living Next to the Hog Facility</u>

8. The hog sprayfields are no more than 200 to 300 yards away from my home in Wallace. Given how close my family lives to the hog facility, and the sprayfields in particular, many members of my family, myself included, have been exposed to the odor and harmful pollutants that come from raising animals in confinement.

9. I don't know exactly how the effects from the hog waste have impacted my health or the health of my family. But I do know that I have lived near a lot of hog farms for almost my whole life and I have always been sick or had some kind of virus. I was recently sick. I think the chemicals that I'm surrounded by, including those from the hog facilities, have something to do with it.

10. I am concerned about the groundwater because of the hog farms. We used to have well-water at my mother's house in Rose Hill, but now we don't know what is in the water. There used to be a time when we could drink the ditch water by just adding a purification tablet in it and we'd be fine. We did this in the military often. Now, however, if you do that, we don't know how useful it is because there are so many chemicals in the water from the hog farms.

11. We started getting town water at our home in Wallace not long after we moved in. Before that, we only had well-water. When the town first offered town water, we signed on as soon as we could. If we didn't have town water and we wanted to get it now, it would be much more expensive, like $500-600. When the town offered it several years ago, it was only $25-50.

12. When the hog waste is sprayed, the smell of ammonia is very overpowering. When the hog farmer sprays the waste, it's basically strong hog urine. It will either burn my eyes or if it gets on my clothes, it will leave a residue.

13. When I smell the hog waste, I do not stand outside or cook outside. I don't want to cook while the hog waste is being sprayed. My family and I try to avoid being outside if we smell it at all. If we have plans and if the hog waste is being sprayed, we have to change our plans. If the hog farmers decide to spray, we are going to smell the waste. It always depends on how much he sprays and how open their valve is.

14. Now, we don't sit on the porch because we don't know what chemicals are going to come in. There are many diseases associated with these hog farms such as PED. All these hog farms get infected with it. PED is a disease that hogs get. Even before the PED, hogs had other diseases. We don't know what is in the waste the farmer is spraying. If a hog has a disease and the farmer is

spraying its waste into the field and it gets into the air from the mist, we don't know how that will affect our health.

15. We used to have a clothesline outside. Everyone used to have a clothesline. When the farmer sprays, the smell gets in your clothes. We don't want to put our clothes on and smell like the hog waste. If you did want to use a clothesline, you'd have to pick a day when the farmer doesn't spray, but we don't know when that is. If we put our clothes outside, and the farmer started spraying, we would have to run out and get our clothes and they might not even be dry. We have had to run out to get our clothes before they were ruined with hog waste. We didn't like being worried about whether the spray would ruin our clothes, so we had to get an inside dryer.

16. When it rains, the hog farm usually doesn't spray. But if we get a lot of rain, the rain runs off of the lagoons.

17. There is also the problem of dead boxes, which are full of dead hogs, which attract buzzards and flies. They smell the dead hogs. Not that long ago there weren't that many buzzards. Now, it is against the law to shoot buzzards, and their numbers have increased. The buzzards are a nuisance. Where I live, there are more flies than one would normally expect because we have the hog waste and the flies come with the hog waste. Some years, the flies are very bad.

18. I like to hunt, but living near a hog farm makes it difficult. Sometimes I hunt in South Carolina. I hunt mostly deer and I cook deer.

19. I believe that the hog farm will affect my property value. If I try to sell this place to someone, from New York City for example, they'll come to get away from the city for fresh air, but if they ask about the hog farms, it might be a letdown for them and for me too. I would be on the losing end.

20. When we were young, my father used to farm and have hogs. Back then, when you had hogs, the hogs didn't have the strong smell of ammonia associated with them and there weren't sprayers back then. We had hogs out on the ground, in the field. If it smelled bad it was because the hog food was rotting, not because of the hog waste itself.

21. We can't do anything now because of the big hog farms. I've been in the middle of grilling and they've sprayed. It takes away from the enjoyment when I can't cookout and can't sit out on the porch with my family.

How the Community is Affected by the Hog Farms

22. There are hog farms near Rainbow Baptist Church. I've been attending this church my whole life. The hog farm located nearby has only been there 12 to 15 years. They have more hog farms nearby now. Right before you arrive at the church there are hogs, and as you drive down on the road by the side of the church, there are hogs – the hog farms are all around the church.

23. The hog farms affect the church goers the same as others anywhere else. Not long ago they had a kid's day and the farmers were spraying. I hope that when the church has family days or special activities that the hog farms aren't spraying because I am concerned about people breathing in the smell and being exposed to the chemicals.

24. Most of the spraying is in poor neighborhoods. You don't see the spraying in rich neighborhoods. Most of the time, if you see a wealthy person near a hog house, that person owns the hog house.

25. I have seen a farmer put hog waste in trucks and drive it to different places to be sprayed. The truck has a sprayer behind it and they take the waste from the truck and spray it in the fields. The trucks will go a mile or two down the road and spray until they run out of it.

26. I think they should do something different with the waste that they pump. It doesn't need to be so close to a person's home because otherwise, they have to smell it. The waste needs to be broken down to be less toxic.

27. I am very surprised that something is not being done because you have restaurants around these hog farms that smell bad. You can smell the hog waste before you get to the restaurant.

28. My mother's house is exactly [redacted] from Valley Proteins animal re-processing facility in Rose Hill. The smell was so strong that it would burn my

eyes from two miles away. What about those people who live less than two miles away from it? When my dad worked there, I asked him how he could bear to eat his lunch there, since it smelled so bad.

29. Lundy's is a pork processing facility in Clinton, North Carolina. I visit Clinton to get my tractor serviced. If you get a chance to go to Clinton, you will see that it is now owned by Smithfield. The smell is so strong there that two miles outside of Clinton, you can smell it. There is also another noxious smell from sewage down the road. If all this is occurring in the town, what is this saying about the environment? Someone is sweeping something under the rug. I don't understand how the people can walk around there.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Wallace, North Carolina on August 8-30 2014

Signed: [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

[redacted]

Exhibit 12

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted] in [redacted] (See Attached Map). I am [redacted] years old and I am employed as manager of the cafeteria for Rose Hill Elementary School. This home belonged to my mother, until her death in 2002. She left the house to me. My family has lived here for over 100 years.

3. I live near a hog farm. The nearest hog farm is about a third of a mile away from my home.

4. The school where I work is about ten minutes from the nearest hog farm and about thirty minutes from my home.

5. I live with my husband [redacted] and my daughters [redacted] and [redacted]

6. Both my husband and I suffer from high blood pressure.

Experience Living Next to the Hog Facility

7. Living near a hog farm has made things difficult. It is embarrassing to invite people to our home because of the smell from the hog farms. The summer is especially bad. We cannot sit outside because I used to feel waves of mist from the sprayers when I sat outside on the porch with my mother. My eyes begin to burn and hurt if I stay outside while the farmer is spraying. Our friends ask why we let people do this to us, but there is really nothing we can do.

8. There are usually two or three days a week when the odor is really bad, but we never know when they will spray. We used to see the spray, but since the owner put up trees in between our homes and the farms, you have to look through the trees to see it. Before the trees were there, the spray used to hit the clothes drying outside my mother's house.

9. We used to do a lot of cookouts in the summertime. My mother also used to have everyone come over here for Thanksgiving and other holidays. But now, if we want to get together and do something outside, we don't do it here. We never know when the farmer will start spraying so we don't want to take a chance that our cookout or party will be ruined. The last time we had a gathering here was May 2013, when my brother passed away. We did it here because we brought him home where he was born. Before the gathering, that it had been years, I don't remember the last time we did a cookout or anything here before that.

10. Sometimes my daughter, [redacted] will go out, but she always comes back in really quickly. Sometimes she just gets to the door and turns right back. The smell isn't as bad inside, especially when we turn the air conditioning on. I wish we could open the doors and get the breeze flowing through the house, but we cannot do that.

11. I live next to my aunt and other family members, but we cannot stay outside and talk to each other or, if we do, we must keep our conversations very short. Sometimes the odor is so strong that we have to cover our mouths with a cloth. Sometimes the smell gets so bad that it wakes my daughter and me up in the middle of the night. It's hard when the odor wakes us up at one or two o'clock in the morning. We can't do anything but spray a little perfume or something. My mother used to use Pine-sol all the time to keep a fresh odor going through the house. I have to do that now, too.

12. Before she passed away, my mother suffered from congestive heart failure and her doctor told her she needed to walk. She was sick and quite old so she was a slow walker. She would try to walk toward my aunt's house next door, but we did not feel safe spending time outside because of the spray. No one wants to inhale the spray and the odor, but it was even worse for my mother. Because of the hog farm, my mother had to walk back and forth inside the home in order to exercise like the doctor told her. We both wished we could have walked outside.

13. I have always had many concerns about living so close to the hog farm. Hogs carry diseases and I worry about the manure from the sprayers going into the air and the ground. I worry about my family inhaling the spray and the odors because it might cause respiratory problems. The farm is so close. We used to use well water but I was concerned about the water quality. We switched to town water before my mom passed away, but I don't remember the exact year. It's not the best tasting water and it does not have the best odor. I don't know what system the water comes from but sometimes it has a bad odor.

14. The spraying has had some effects on the community. We can't go outside and sometimes the spray will hit the highway so we have to drive farther out of our way so the spray won't hit our cars. The farm owner put in some trees between our home and the farm so that helps keep the spray off of our cars when we are home. The farm owner's daughter even had to move her doublewide trailer away from the road because it would have been hit by the spray.

Changing the Hog Farm System

15. A hog farm can really mess up a nice community. I want to know how many farms the state is going to allow. There's one here and it seems like it is just continuing. I don't think there's anything we can do to stop the hog farms and I don't think there are good regulations on these farms. The hog farmers are

making a living by harming my family and me. They are allowed to spray all over people's homes in some places. I want to know when it will stop.

16. I don't know what the farms should do differently, but they need to fix the odor somehow. Maybe they could do something underground, maybe pump the waste out like people do with septic tanks. They could set limits on how many miles away the waste has to be from where people live.

17. My neighbors all complain about the odor too, but they don't do anything about it. I think that they don't like to get involved because they know the farm owners and they don't want to make trouble. I think a lot of people are afraid to say anything because they work in the hog farm industry. I think they are afraid to lose their jobs. I understand it but I think we all deserve better.

18. When I think about the fact that we deserve better, I always just think back to my mom. She needed to walk but she couldn't even do it outside. My family should be able to step out onto our porch and enjoy our yard. Instead we can't even talk comfortably outside. As soon as we drive near our house we have to roll the windows up. It's not fair and no one is trying to fix anything. People are fine with having the hog farm here; they just don't want to be living here. The people who are earning money off of the farms should at least try to fix some of the problems. When we drive by we can see swarms of flies so you know it's really smelly everywhere around the farms. Some higher-up at the farm needs to

spend some money to fix these problems. Life is too short to live like this, with no cookouts or walks outside or time on our porch. I wonder why the farmers don't put a hog house some other place. I wonder why they chose to put the farm here. We've always been here.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Wallace North Carolina on August 30 2014.

Signed [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

Exhibit 13

DECLARATION OF TARA [redacted]

1. My name is [redacted] I am [redacted]ears old. I am giving this statement with my mother's permission. All of the information herein is based on my own personal knowledge unless otherwise indicated.

<u>Background</u>

2. I am African-American. I live at [redacted] in [redacted]orth Carolina. (See Attached Map). I have lived in this house my whole life. I live with family members, including [redacted] and my mother, [redacted] I have a pet hamster, and my aunt, who lives nearby, has a dog.

3. I am a student at Wallace Rose-Hill High School. I just finished 9th grade.

<u>Experience Living Next to the Hog Facility</u>

4. I smell the odor that comes from the hog farm that is near our home about five to 10 times a month. I usually stay inside when it happens. The closest hog farm to my house is less than half a mile away.

5. When I am outside, I do not stay out long. I might go out, throw a ball around two or three times and then come back inside because I don't want to smell the odor. I don't play on the trampoline or play with the dog because of the smells from the hog farms.

6. If we didn't have these hog issues, I would be outside most of the time. I like being outside. Especially when the weather is nice, I would like to be outside all day, but because of the hog issue, I am rarely able to stay outside. I could go to the park in order to have more time outside, like a kid should have, but the closest park that is less affected by hog farm odors is too far away for me to walk and I do not drive.

7. All my family agrees that there is a strong odor from the hog farms. We discuss it with relatives sometimes. Some of the members in my family say that their [redacted] burn when they smell the odor.

8. Whenever we try to have a cookout, we'll be in the middle of cooking and then we start to smell the odor and we have to move inside.

9. Hog farms affect where I want to live when I grow up. I don't want to have to live somewhere where it smells bad because of the hog farms.

10. I love animals—any kind of animals. I love dogs. I had a hamster named Theodore. I bought him and I came home and saw that he only had three legs, but we kept him because most people would have probably just rejected him. I feel that what those hogs have to go through is torture. It's not right. I would hate to be the pig that gets treated like that.

11. I feel that the hog farm issue could be improved if spraying wasn't so close to where people live.

12. I feel that if they continue to raise hogs on these big farms, they could at least change their ways. Instead of making the waste go into the air, they could put it underground. If not that, they could do something to at least take away the smell or move it further away from people's homes into an open field so no one will have to live with it.

I declare, under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge.

Executed in Wallace, North Carolina on August 30, 2014.

Signed: [redacted]

Signed: [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

Exhibit 14

DECLARATION OF (b) (6) Privacy(b) (6) Privacy [redacted]

1. My name is JoAnn Burkholder. I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

<u>Professional Background</u>

2. I am a William Neal Reynolds Distinguished Professor at North Carolina State University ("NCSU"), and the director of the NCSU Center for Applied Aquatic Ecology. I hold joint appointments in the Department of Applied Ecology and the Department of Plant and Microbial Biology. I also am an Affiliate Professor in the Department of Marine, Earth, and Atmospheric Sciences.

3. My research interests include algal nutritional ecology across freshwater and marine species. I also study the chronic effects of eutrophication, or nutrient over-enrichment, and associated pollutants on aquatic ecosystems, with particular focus on the impacts and mitigation of harmful algal blooms including eukaryotic algae and cyanobacteria.

4. I have a B.S. in Animal Ecology (Zoology) from Iowa State University, a M.S. in Aquatic Botany from the University of Rhode Island, and a Ph.D. in Botanical Limnology from Michigan State University.

5. A copy of my Curriculum Vitae is attached hereto as Exhibit 1.

Professional Experience Studying Industrial Swine Facilities

6. I have been familiar with the impacts of industrial swine facilities on the environment and surrounding communities for about 20 years, since the occasion when I monitored a swine effluent lagoon rupture to receiving waters in June 1995.

7. On that occasion I received an emergency call from concerned citizens the day after a lagoon ruptured at a confined swine operation with approximately 12,000 animals. About 25.8 million gallons of raw effluent from spilled from the lagoon into a nearby tributary to the New River.

8. From my review of the North Carolina Department of Environment, Health, and Natural Resources records, as well as records from the North Carolina Division of Water Quality, it is my understanding that practices at the operation contributed to the spill. The operator had installed a pipe through the lagoon's earthen wall to facilitate effluent transport to the fields, which was improper practice. The pipe weakened the wall and promoted the rupture when the lagoon volume approached the maximum holding capacity for the lagoon.

9. By the time personnel from my laboratory were able to go to the location of the spill and investigate, there was a complete mess in the receiving stream. The waste had flowed overland before draining into a small freshwater second-order segment of the New River. The receiving stream had only been three

feet wide, and it had been inundated with 25.8 gallons of high volume waste. Fish were hanging from the bushes along the stream path; they had been blown from the water by the high-volume waste. The conditions were filthy and stark. By that time the leading edge of the plume had moved about 17 miles downstream from where the waste effluent spill had occurred. The water contained no dissolved oxygen even at the surface, and all of the fish we encountered were dead, even hardy species such as gar. Analyses of the stream water samples we collected at the leading edge of the plume later revealed that fecal coliform bacterial densities were at more than one million colony forming units ("cfu") per 100 milliliters ("mL") at many sampling locations the day after the lagoon rupture, including the site noted above that was 17 miles downstream.. These concentrations were much higher than the state standard for safe human contact with fecal coliforms, which is 200 colony-forming units per 100 milliliters (cfu/100 mL). The high concentrations of fecal coliforms posed a human health hazard. Every one of us from my laboratory who sampled the water or surficial sediments (upper inch of bottom mud in the stream where the effluent had passed) sustained flu-like conditions that persisted for about two weeks after the sampling date.

10. Two to three weeks after the spill - in other words, after a lag period - there was a major algal bloom downstream in the New River Estuary. Based on previous data for the area, the algal biomass was atypical; it was very high and in

violation of the state standard (40 micrograms of chlorophyll *a* per liter; chlorophyll a is used across the fields of limnology and estuarine science as an indicator of algal biomass).

11. My lab initially did not have funding to sample in the area, but we managed to get funds to conduct limited tests for fecal coliform bacteria and other microbes including certain harmful algae known to thrive in nutrient-polluted waters such as *Phaeocystis* and *Pfiesteria piscicida* and a second *pfiesteria*-like species. We also tested for suspended solids and common nutrients, including phosphorus, nitrate, and ammonium. We found extremely high levels of pfiesteria-like species even 17 miles downstream of the spill, at 1,200 cells/mL, whereas cell densities previously found in the area had been only at ~50-100/mL. Laboratory tests indicated that the populations were capable of toxin production. We published our complete, peer-reviewed findings in the *Journal of Environmental Quality* (*JEQ*) (Burkholder et al. 1997, Impacts to a Coastal River and Estuary from Rupture of a Large Swine Waste Holding Lagoon, *JEQ* 26: 1451-1466, attached hereto as Exhibit 2).

12. The spill occurred near the end of June, with the Fourth of July holiday following shortly thereafter. News reports (for example, a *Raleigh News & Observer* article by Stuart Leavenworth cited in Burkholder et al. 1997), focused on how the spill impacted nearby recreational areas, including the marina in

Jacksonville, North Carolina. Such reports noted that submersed surfaces (dock pilings, boats etc.) in the Jacksonville marina, a site traversed by the swine effluent from the ruptured lagoon as the effluent moved downstream, were coated with a brown, foul-smelling material.

13. At the time, I had been appointed to the North Carolina Marine Fisheries Commission, where I was serving as the chair of the Habitat and Water Quality Committee. In that capacity I had been charged with translating the implications about water quality data to the general public - that is, informing the public about what the data meant in terms of water quality impacts, fish health and human health. Many people were calling me to tell me that they felt that the spill posed a big economic problem and they also expressed concern about whether the water was safe. They were noticing brown, foul smelling material in the water. People wanted to be able to get out into the water for the holiday, but wanted to know whether it was safe. Some of them also wanted to help clean up the area and asked if they, and their families, could wade out into the water and try to help with cleanup. I had to tell them that it was not safe to be in the water. Even four weeks after the spill, the surface sediments that we sampled had high concentrations of fecal bacteria. There are more than 100 pathogenic microorganisms in swine waste that could cause impacts to human health (compiled by J. Burkholder from references cited in the Burkholder et al. 1997 paper - e.g. Kofer 1992, Dewi et al.

1994, Salmon et al. 1995; also see Council for Agricultural Science and Technology 2008, *Fate and Transport of Zoonotic Bacteria, Viral, and Parasitic Pathogens During Swine Manure Treatment, Storage, and Land Application* - Special Publication No. 29, Ames, Iowa).

14. *Clostridium perfringens*, found in swine wastes, was detected in the stream area traversed by the swine effluent plume, 5 days after the lagoon rupture, at about 460 cfu/100 mL. This organism can seriously impact human health; for example, it can cause gangrene (see, for example, the *Medline Plus Medical Encyclopedia* as a general reference, http://www.nlm.nih.gov/medlineplus/ency/article/000620.htm).

15. After sampling the stream and estuary that received the swine effluent spill in 1995, I obtained a grant to conduct research into whether waste from industrial swine facilities can contribute to the growth of harmful algae such as *Pfiesteria* species. My research found that the swine waste provided a better environment for the *Pfiesteria*, and contributed to their proliferation. This information was published in a peer-reviewed paper (Burkholder and Glasgow 2001, History of toxic *Pfiesteria* in North Carolina estuaries from 1991 to the present, *BioScience* 51: 827-841). Indirect stimulation of *Pfiesteria* species by nutrient enrichment was also shown in other published research (e.g. Gilbert et al.

2006, Direct uptake of nitrogen by *Pfiesteria piscicida* and *Pfiesteria shumwayae*, and nitrogen nutritional preferences, *Harmful Algae* 5: 380-394).

16. It is not surprising that harmful algae are stimulated directly or indirectly by nutrient pollution; in fact, scientists have reached consensus that many harmful algae are stimulated by nutrient pollution from a wide array of sources (see Heisler et al. 2008, Eutrophication and harmful algal blooms: A scientific consensus, *Harmful Algae* 8: 3-13).

17. The most common example of nutrient pollution stimulating harmful algal species is that of cyanobacteria. Many potentially toxic cyanobacteria, which can cause serious human disease as well as fish and wildlife kills, thrive in waters that are degraded by nutrient pollution (reviewed in Burkholder 2002, Cyanobacteria, pp. 952-982 in *Encyclopedia of Environmental Microbiology*, by Bitton G (ed.), Wiley Publishers, New York). I have found abundant potentially toxic cyanobacteria in waters that were impacted by these spills (see the Burkholder et al. 1997 publication), and toxic cyanobacteria have been reported by others in waters and wetlands contaminated by swine effluent (e.g. Schwarz et al. 2004, *Environmental Contaminants Associated with a Swine Concentrated Animal Feeding Operation and Implications for McMurtrey National Wildlife Refuge*, U.S. Fish & Wildlife Service, Grand Island, Nebraska). Swine wastes are rich in nutrients for cyanobacteria (Markou and Georgakakis 2011, Cultivation of

filamentous cyanobacteria (blue-green algae) in agro-industrial wastes and wastewaters: A review, *Applied Ecology* 88: 3389-3401). Cyanobacteria are especially known to be "phosphorus-loving" - that is, they grow optimally at high phosphorus concentrations which are typical of waters degraded by swine effluent (see the Burkholder et al. 1997 publication; also see, as examples, Mallin 2000, Impacts of industrial-scale swine and poultry production on rivers and estuaries, *American Scientist* 88: 26-37; and Mallin et al. 1997, Comparative impacts of effluent from poultry and swine waste holding lagoon spills on receiving rivers and tidal creeks, *JEQ* 26: 1622-1631).

18. Another example is that of *Pheocystis* species, which have been reported to thrive in areas degraded by raw (untreated) sewage (see the supporting references given in the Burkholder et al. 1997 paper). Thus, it was not surprising that we documented a bloom of *Pheocystis* in the New River Estuary, where high abundance of *Pheocystis* had not previously been documented, after that area was impacted by the swine effluent spill.

19. A third example of harmful algal abundance being linked to nutrient pollution is as follows: Whereas high phosphorus can stimulate the growth of some harmful algae, others are stimulated by high nitrogen concentrations such as the excessive ammonia found in swine effluent (see supporting data, for example, in Burkholder et al. 1997; also see supporting references in Burkholder et al. 2007,

attached hereto as Exhibit 3). In her doctoral thesis research, Dr. Megan Rothenberger (professor at Lafayette College in Pennsylvania) studied another estuary in North Carolina that drains areas with industrialized swine production. That estuary has sustained a 500-fold increase in ammonia that has been related in part to the swine industry (see Burkholder et al. 2006, Comprehensive trend analysis of nutrients and related variables in a large eutrophic estuary: A decadal study of anthropogenic and climatic influences, Limnology & Oceanography 51: 463-487). Dr. Rothenberger found a strong positive relationship between ammonia concentrations and the abundance of other harmful algae such as the potentially toxic raphidophyte, *Heterosigma akashiwo* (see Rothenberger et al. 2009, Multivariate analysis of phytoplankton and environmental factors in a eutrophic estuary. *Limnology and Oceanography* 54: 2107-2127). Dr. Rothenberger's work also indicated that industrialized swine production was the most important source of water quality degradation to the lower river and estuary that she studied (see Rothenberger et al. 2009, Long-term effects of changing land use practices on surface water quality in a coastal river and lagoonal estuary. *Environmental Management* 44: 505-523).

20. I directed or participated in many of the studies referred to above. In addition, on various occasions my laboratory has tested waters that were impacted by swine wastes for concerned citizens groups (NGOs such as Waterkeepers

Alliance or the Neuse River Foundation, now known as the Neuse Riverkeeper Foundation) or for legal entities representing them such as Earthjustice. I knew that the samples were from waters impacted by swine wastes because, in some cases, the people involved asked personnel from my laboratory to help them sample. They did so because they wanted to make sure that the sampling was properly conducted, and my laboratory is State-certified for water quality analysis of the parameters we analyzed in the data we provided. In other cases, the people involved provided aerial maps of the swine operations and the maps also indicated where samples were taken. It was important for my laboratory personnel to know this information because they were in direct contact with the samples. As I explained above, there are many microbial pathogens in swine effluent and waters affected by swine effluent that can cause serious human disease. Accordingly, my laboratory personnel took careful precautions when analyzing such samples; they not only followed typical protocols (lab coat, gloves, goggles etc.) but also minimized contact with any aerosols produced during sample analysis by working in a fume hood.

21. I have also conducted extensive reviews of the scientific literature on swine waste contaminants and impacts of swine wastes on receiving waters. I did so (i) in preparation for writing the Burkholder et al. (1997) publication; (ii) in assisting in the writing of the Mallin et al. (1997) publication - I also collaborated

with Dr. Mallin in that study and my laboratory personnel and I assisted in sampling; (iii) in preparation for various presentations I have given in national scientific forums over the period from 1996 to 2004 (in Missouri, Minnesota, Rhode Island, Wisconsin, New York, and Maryland, as well as North Carolina); (iv) in preparation for giving lectures about impacts of the swine industry on surrounding natural resources (*Environmental Issues in Aquatic Ecology* - a graduate level course I taught at NCSU, generally every other year, from 1992 to 2011); (v) in preparation for leading the Burkholder et al. (2007) publication, wherein I collaborated with six other scientists; and (vi) in preparation for submitting comments about water quality data from samples collected near an industrialized swine operation in Arkansas (2014 - the C&H Hog Farm, a confined swine feed operation that recently began operations in northwestern Arkansas along Big Creek, a tributary of the Buffalo River - comments requested by Attorney Monica Reimer, Earthjustice, Tallahassee, FL). Thus, I have read the scientific literature in detail about how swine facilities impact the environment (air, soil, and water) and human health. The publications show that industrialized swine production causes chronic (constant, insidious) impacts on surrounding natural resources (air, water, and soils).

Professional Opinion About Impacts from Swine Facilities

22. My professional experience, described above, strongly supports my

conclusion that swine facilities contribute significantly to environmental and human health problems in a number of ways.

23. Swine facilities in North Carolina land-apply liquid waste to sprayfields. In the area "down east" in North Carolina where most industrialized swine operations are located, the soils are sandy and shallow (depth only about three feet to the water table) (see the review in Burkholder et al. 1997). The shallow, sandy soils simply cannot absorb the massive amounts of waste the industry applies to those soils, time after time per season, year after year. Waste that is applied to the fields tends to percolate into the shallow groundwater and then moves to receiving streams and rivers (see, for example, Evans et al. 1984, Subsurface drainage water quality from land application of swine lagoon effluent, *Transactions of the American Society of Agricultural Engineers (Trans. ASAE)* 27: 473-480).

24. Swine facilities store the waste in pits, called lagoons by the swine industry, before the waste is applied to the fields. Areas around the cess pits have been shown to receive leakage from the cess pits. Studies have shown that wells and subsurface seepage near the cess pits can be contaminated with levels of extremely high nitrate and high ammonia, such as described in Huffman and Westerman (1995, Estimated seepage losses from established swine waste lagoons in the lower coastal plain of North Carolina, *Trans. ASAE* 38: 449-453),

Westerman et al. (1995, Swine-lagoon seepage in sandy soil, *Trans. ASAE* 38: 1749-1760), and Ham and DeSutter (2000, Toward site-specific design standards for animal-waste lagoons: protecting groundwater quality, *JEQ* 29: 1721-1732).

25. The high nitrate levels are a result of the high ammonia levels because the ammonia is oxidized to nitrate as it moves away from the waste source in surface runoff and groundwater (see Burkholder et al. 1997, 2007, and references therein). High concentrations of nitrate are hazardous to human health, especially for babies and small children (methemoglobinemia or 'blue-baby syndrome') because nitrate competes with oxygen for hemoglobin (see Smith 2009, The Blue Baby Syndromes, *American Scientist* 97: 94-96; Knobeloch et al. 2000, Blue Babies and Nitrate-Contaminated Well Water, *Environmental Health Perspectives* 108: 675-678).

26. North Carolina's drinking water standard for nitrate is less than 10 milligrams per liter (mg/L) (North Carolina Department of Environment and Natural Resources [NC DENR], Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina, NC Admin. Code Section 15A NCAC 2B .0200, Environmental Management Commission, Raleigh, NC; see http://portal.ncdenr.org/c/document_library/get_file?uuid=ad77b198-aa3d-4874-9723-54ce730b3a8d&groupId=38364). The available data indicate that many of the unlined swine effluent cess pits in eastern North Carolina cause nitrate

pollution to nearby wells at levels that violate the 10 mg/L drinking water standard (e.g. Huffman 2004, Seepage Evaluation of Older Swine Lagoons in North Carolina, *Trans ASAE* 47: 1507-1512).

27. Moreover, much lower concentrations of nitrate (0.25-2.8 mg/L) can cause disease and death of beneficial aquatic life (Camargo et al. 2005, Nitrate toxicity to aquatic animals: A review with new data for freshwater invertebrates, *Chemosphere* 58: 1255-1267; and Camargo and Alonso 2006, Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment, Environment International 32: 831-849). Nitrate can interfere with steroid hormone synthesis, affect sperm motility and viability, affect fecundity, and can be toxic to embryos (Edwards et al. 2004, *Effects of Nitrate/Nitrite on Two Sentinel Species Associated with Florida's Springs*. Final report, prepared for the Florida Department of Environmental Protection, Tallahassee, FL). It can also decrease immune response, act as an endocrine disruptor, and induce hematological and biochemical changes in beneficial aquatic life (Guillette and Edwards 2005, Is nitrate an ecologically relevant endocrine disruptor in vertebrates? *Integrative and Comparative Biology* 45: 19-27).

28. Swine facilities pose a significant threat to well water via contamination with contaminants such as pathogenic microbes and nitrate (e.g. Huffman 2004; also see Stone et al. 1998, Impact of Swine Waste Application on

Ground and Stream Water Quality in an Eastern Coastal Plain Watershed, *Trans. ASAE* 41: 1665-1670; Krapac et al., 2002, Impacts of swine manure pits on groundwater quality, *Environmental Pollution* 120: 475-492). Many North Carolinians, including populations on the Coastal Plain, rely upon groundwater as their drinking water source (see North Carolina Groundwater Association, http://www.ncgwa.org). As noted above, both the land application practices and the cess pits ("lagoons") threaten to substantially contaminate groundwater, including groundwater that supplies these wells.

29. The potential for well water contamination in eastern North Carolina is high because many lagoons were built close to wells. From my review of North Carolina regulations involving the swine industry - in particular, the official description of industrialized swine production as "family farms" prior to 1993, so that the operators could and did dig unlined cess pits within 50 feet of a neighboring person's well - my understanding is that the majority of the swine effluent cess pits in eastern North Carolina were installed without any liners prior to 1993 (and "grandfathered in" after clay liners were required on cess pits dug thereafter - see Burkholder et al. 1997 and Huffman 2004, and references therein), within very close proximity of wells used as potable water supplies. The liners would have helped to reduce the wastes from leaching into soils and groundwater, but they are lacking in the majority of the cess pits used to hold the wastes.

30. In addition to groundwater pollution, waste applied to the sprayfields can cause significant pollution to surface waters. When the waste is not absorbed into the soil, for example if it is over-applied or applied on already saturated fields, it can run off over land to nearby surface waters or conduits to surface waters. Over-application of swine wastes or application of swine wastes to saturated soils can cause contaminants to move into receiving waters through runoff and to leach through permeable soils to vulnerable aquifers. Importantly, this can happen even at recommended application rates. As examples, in eastern North Carolina Westerman et al. (1995, *Trans. ASAE* 38: 1749-1760, cited above) found high levels of nitrate (3-6 mg/L) in surface runoff from sprayfields that received swine effluent at recommended rates. Also in eastern North Carolina, Stone et al. (1995, Water quality status of a USDA water quality demonstration project in the Eastern Coastal Plain, *Journal of Soil and Water Conservation* 50: 567-571) measured 6-8 mg of total inorganic nitrogen/L and 0.7-1.3 mg of phosphorus/L in a stream adjacent to swine effluent sprayfields. In North Carolina, as well, Evans et al. (1984, cited above) reported 7-30 mg nitrate/L in subsurface flow draining a sprayfield for swine wastes, applied at recommended rates.

31. Waste application has also led to soil contamination. Swine feed often contains metals, and these metals persist in the swine waste, which is then applied to the fields. Sensitive crops often cannot withdraw the metal from the soil,

leaving it behind to accumulate in the soil. Research done in eastern North Carolina explained how waste application contributes to metal pollution in fields and showed that by the mid-1990s, some counties receiving swine effluent application had soils that could no longer be used to grow metal-sensitive crops (see Barker and Zublena 1995, Livestock Manure Nutrient Assessment in North Carolina, final report, NC Agricultural Extension Service, NCSU, Raleigh, NC; and Zublena et al. 1995, Capacity of North Carolina Crops to Use Animal Manures: A Nutrient Balance Approach, Soil Science Notes, NC Agricultural Extension Service, NCSU, Raleigh, NC).

32. Research has also shown that industrialized swine production facilities emit copious air pollutants known to adversely impact human health. For example, researchers have documented ammonia and hydrogen sulfide in the air from the swine facilities (see, as examples, U.S. EPA 1998, *Environmental Impacts of Animal Feeding Operations*, Office of Water, Standards and Applied Sciences Division, U.S. EPA, Washington, DC - and references therein such as Aneja et al. 1998; and Liu et al. 2014, Ammonia and hydrogen sulfide emissions from swine production facilities in North America: a meta-analysis, *Journal of Animal Science* 92: 1656-1665).

33. Ammonia that is volatilized from the confinement houses and the sprayfields can also impact water quality. The volatilized ammonia returns to the

surface where it can contaminate surface waters (Aneja et al. 2003, Agricultural ammonia emissions and ammonium concentrations associated with aerosols and precipitation in the southeast United States, Journal of Geophysical Research 108(D4): ACH12-1 - 12-11). My research team documented a 500-fold increase in ammonia concentrations in the Neuse Estuary over the period from 1993-2002, the decade when swine production exponentially increased in the watershed (see Burkholder et al. 2006, cited above). A significant increase in ammonia concentrations was similarly documented in the Cape Fear River, which had about four-fold more swine in its watershed than the Neuse (see the same publication).

34. Ammonia is a preferred form of nitrogen by many algal species including various harmful algae (e.g. Collos and Berge, Nitrogen Metabolism in Phytoplankton, Encyclopedia of Life Support Systems - http://www.eolss.net/sample-chapters/c09/E2-27-03-03.pdf; Herndon and Cochlan 2006, Nitrogen utilization by the raphidophyte *Heterosigma akashiwo*: growth and uptake kinetics in laboratory cultures, *Harmful Algae* 6: 260-270; Twomey et al. 2005, Phytoplankton uptake of ammonium, nitrate and urea in the Neuse River Estuary, NC, USA, Hydrobiologia 533: 123-134). My research into the spill in 1995 found ammonia concentrations as high as ~40 mg/L in the stream contaminated by the swine effluent (Burkholder et al. 1997). Such concentrations, depending on the pH, can be toxic or inhibitory to aquatic life (see Camargo et al.

2005, Camargo and Alonso 2006, cited above, and references therein), but would be expected to stimulate noxious algal growth as the concentrations became more dilute downstream.

35. In the Neuse watershed, research has identified pollution from industrialized swine production as the most important cause of water quality degradation in the mid- to lower Neuse (see Rothenberger et al. 2009, *Environmental Management*, cited above).

36. Swine facilities contribute to other very serious impacts on the surface waters, from sediment loading and turbidity. The water near swine facilities is often dark and murky, and inhibits plant growth (e.g. see Burkholder et al. 1997 and Mallin 2000, cited above, and references therein).

37. From 1995 to the present, my laboratory has worked with concerned citizens and NGOs to help them test surface waters. In more than 30 years of experience beginning in central Iowa where I earned my Bachelor of Science Degree and studied stream pollution by agriculture, I have not found concentrations of phosphorus and inorganic nitrogen as high as I have measured them in waters that have recently sustained swine waste pollution (e.g. up to ~40 mg ammonium/L as described above, and up to 4.79 mg total phosphorus/L - Burkholder et al. 1997).

38. Another impact I commonly have seen in waterways contaminated by

swine waste is an extremely low dissolved oxygen content. Swine wastes are rich in organic matter, relative to human waste or other animal wastes (see review in Burkholder et al. 1997). The bacteria in swine waste consume all of the oxygen in decomposing the organic-rich swine wastes. The resulting low oxygen concentrations, in turn, cause fish to suffocate (see Burkholder et al. 1997, Mallin 2000; also see U.S. EPA 1998, cited above, for fish kills linked to swine effluent contamination of waterways). A recent modeling effort (funded by the North Carolina General Assembly through NC DENR) concluded that elimination of human sewage discharges to the lower Cape Fear River would have no appreciable effect on dissolved oxygen levels, which commonly do not meet the State standard of 5 mg/L (Bowen et al. 2009, *Development and Use of a Three-Dimensional Water Quality Model to Predict Dissolved Oxygen Concentrations in the Lower Cape Fear River Estuary, North Carolina* - see http://coefs.uncc.edu/jdbowen/lcfr). However, the modeling study also found that reduction of nonpoint source pollution (modeled as tributary inputs), which is almost entirely contributed by the swine industry, would allow the dissolved oxygen standard to be met; in fact, dissolved oxygen would be even higher than the state standard.

39. A major concern about the potential impact from all of the swine facilities in North Carolina is that the waste from these facilities will contribute to

outbreaks of harmful algae such as toxic cyanobacteria (blue-green algae) in freshwaters and *Heterosigma akashiwo* in estuaries (see Rothenberger et al., *Limnology and Oceanography* and Schwarz et al. 2004, cited above).

40. Cyanobacteria make toxins that can cause liver hemorrhaging as well as neurological and psychological impacts (see reviews in Chorus and Bartram 1999, *Toxic Cyanobacteria in Water - A Guide to Their Public Health Consequences, Monitoring and Management*, E&FN Spon for the WHO, New York, New York; Burkholder 2002, cited above). Cyanobacteria can cause burning eyes, skin irritation, and make toxins that promote tumors, as described in those publications. People can be exposed to the toxins from cyanobacteria by ingesting the water (which commonly happens when children play in an area affected by a cyanobacteria outbreak or bloom), or by touching the water or inhaling aerosols above the affected area. It is common knowledge and well accepted among scientists worldwide that the toxins from cyanobacteria are potent and can seriously threaten human health.

41. The Cape Fear River, which drains the highest concentration of swine per unit area of anywhere in the nation, has sustained highly toxic cyanobacteria blooms that are dangerous for human health. The algae have bloomed in slower reaches of the river (behind lock-and-dam structures) and contributed to water quality problems downstream. Researchers at the University of North Carolina,

Wilmington recorded levels as high as 390 micrograms of the toxin per liter in the Cape Fear [see Isaacs et al., 2014, Microcystins and two new micropeptin cyanopeptides produced by unprecedented *Microcystis aeruginosa* blooms in North Carolina's Cape Fear River, *Harmful Algae* 31: 82-86; also see Mallin et al. 2014, Unprecedented Toxin-Producing Cyanobacterial Blooms in the Cape Fear River: A Nutrient-Overload Tipping Point?, published abstract from the Summer Meeting of the *Association for the Sciences of Limnology and Oceanography*). The U.S. EPA has not set national guidelines specifying safe levels of toxins from cyanobacteria although cyanotoxins are candidates for drinking water criteria. The World Health Organization (WHO 2003, Guidelines for Safe Recreational Waters, Volume 1 - Coastal and Fresh Waters, Chapter 8: Algae and cyanobacteria in fresh water, WHO, Geneva, Switzerland) recommends that there should be only 1 microgram per liter or less of the common cyanotoxin, microcystin-LR, in drinking water in order to protect human health and safety.

Regulation of the Swine Industry in North Carolina

42. I have reviewed both the previous version and the most recent renewal version of the state general permit for animal waste management systems at swine facilities. In my opinion, the state general permit is seriously inadequate because it does not protect human health or natural resources.

43. Most of the provisions should be strengthened. For example, the permit

should require water quality sampling for streams that are adjacent to the swine facilities before, during, and after rainstorms. *At a minimum*, the state should require testing during three storms per season, not once per year. Precipitation/ runoff provides a means for many of the contaminants in swine wastes to travel to surface waters. The state should be collecting information on how precipitation affects water quality so that NC DENR will be in a knowledge-based position to require permitted facilities to maintain best-management practices that prevent water quality degradation. The soil in sprayfields should be adequately sampled (i.e., not one sample but, rather, adequate *replication* across the sprayfield) at least seasonally - not once per year as in the previous permit or, yet weaker, not once every three years as in this renewal permit.

44. The renewal permit should require rigorous microbial analysis of sprayfield effluent, of the receiving waters in the event of an effluent spill, and of the adjacent or nearby downstream surface waters during and after rain events of ~one inch or more. At a minimum, indicators of microbes that can cause human disease, such as densities of fecal coliform bacteria and *Escherichia coli*, should be measured. The samples should also be tested for nitrogen species (total Kjeldahl, ammonia, nitrate+nitrite) and phosphorus (total phosphorus, soluble reactive phosphorus or orthophosphate) moieties. *Testing is essential so that the state, the scientific community, and the general public can obtain a knowledge-based*

assessment, rather than a guesstimate based on little or no information as required in the renewal permit, of the impacts that the swine waste contamination event has on water quality and the related threat to human health.

45. The renewal permit currently provides that animal waste should not be applied within 100 feet of a well. That distance surely is not based on research that would protect human health. Many studies have shown instead that nitrate from swine facilities can travel a considerable distance, much more than 100 feet (for example, see Hamm et al. 2004, cited above - their review found that high concentrations of nitrate commonly travel at least 100 meters, or ~300 feet from swine facilities). Huffman (2004) reported that in eastern North Carolina, the shallow groundwater on about two-thirds of 34 systems tested would have failed the 10 mg nitrate/L drinking water standard at a distance 125 feet down-gradient from swine effluent cess pits. Research has demonstrated that animal waste should be applied at a much greater distance than 100 feet from a well. Setbacks should be set at distances that err conservatively to protect public health.

46. The renewal permit also does virtually nothing to protect public health safety in the event of a discharge or spill of swine effluent from a permitted swine facility. My experience with the lagoon rupture in 1995, and with other swine effluent contamination of surface waters, highlights the importance of both public notice and water and soil sampling following a swine effluent discharge or spill.

The public should be notified of the swine effluent spill to ensure that people are not exposed to hazardous conditions. The state should sample both the water and soil in the surrounding area, as described above, to understand the extent of the threat to public health and safety so that appropriate mitigation actions can be taken.

47. As to public notice, the permit also fails to protect the health safety of people who may become exposed to swine effluent or to water polluted with it. The permit provides that in the event of a discharge of 1,000 gallons of swine waste, the facility need only issue a press release. For a discharge of 15,000 gallons of waste, the facility must also place a notice of the discharge in a local newspaper, but *within 10 days*. There is no consideration in the permit for the health safety of people exposed to the swine waste-contaminated water for up to 10 days prior to issuance of public notice, which is unacceptable. The failure of public notice means that a family living near the facility will not be warned - if they manage to receive notice the press release - about a threat to their health for up to 10 days after the event. In the event of a spill of one million gallons or more, the permit provides that the appropriate Division should be contacted to determine where to provide notice. This action still, even if a swine effluent spill of this magnitude occurs, does not state anything concrete about concerted efforts that will be undertaken by the State of North Carolina to protect the health safety of its

citizens - including children and the elderly who are more commonly immune-compromised - who, through no fault of their own, become exposed to swine waste-contaminated waters.

48. The permit does not provide for sufficient monitoring in the event of a swine waste spill or discharge. Following a discharge, the permittee is required to notify the regional office and provide information about the discharge, including the results of testing a sample of the waste taken within 72 hours, or *three full days*, after the discharge. Thus, the permit fails to ensure that the waste will be sampled close enough to the event to enable full assessment of the potential threat and impacts to human health.

49. As explained above, swine waste-contaminated waters are a threat to human health. In the event of a swine waste effluent discharge or spill, any contact with the water, from wading into the water and fishing to playing near the water, poses a significant threat to human health, such as gangrene for a child who wades into the water and has a cut on his/her foot or leg (as many children do) through which *Clostridium perfringens* can gain access.

50. The present reality is that *none* of the microbial pathogens and chemical contaminants (such as herbicides and fungicides in the sprayfield runoff) in swine wastes are being rigorously monitored in North Carolina; indeed, most have not been tested for even once, yet this state is the second highest swine producer in the

nation, and it has the highest concentration of swine per unit surface area across the U.S. Several studies have tracked a few contaminants in swine waste-polluted North Carolina surface waters and groundwaters (cited above). Those studies have described major water quality degradation from swine effluent contamination. The actual impacts would be expected to be much worse than have been evaluated because the evaluations to date have not included nearly all of the contaminants in the wastes that can cause human health impacts, and have not considered the potential synergistic interactions of the many contaminants on human health.

51. In my professional opinion, the state renewal general permit for swine waste management systems does not provide mechanisms for sufficient oversight of the swine facilities in North Carolina. Much more needs to be done by the State of North Carolina to ensure that industrialized swine production facilities do not operate to the detriment of human health and the environment.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Raleigh, North Carolina on September 2nd, 2014

JoAnn M. Burkholder

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JoAnn Burkholder

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Exhibit 1

Curriculum Vitae

JoAnn Burkholder

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Jointly Appointed in the Department of Plant and Microbial Biology;
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Education

Undergraduate:	Iowa State University	Zoology	B.S., 1975
Graduate:	University of Rhode Island	Aquatic Botany	M.S., 1981
	Michigan State University	Botanical Limnology	Ph.D., 1986

Research Interests

Algal nutritional physiology and algal culturing, spanning the salinity gradient from freshwater to marine species; and chronic effects of eutrophication (nutrient over-enrichment and associated pollutants) on aquatic ecosystems, especially impacts and mitigation of harmful algal blooms (eukaryotes, cyanobacteria)

Professional Experience

2013 - present	Director, CAAE, Department of Applied Ecology, NCSU
2013 - present	Professor, Department of Applied Ecology; jointly appointed to the Department of Plant & Microbial Biology (formerly the Department of Plant Biology), NCSU
1999 - 2012	Director, CAAE, Department of Plant Biology, NCSU
1998 - 2012	Professor, Department of Plant Biology (formerly the Department of Botany), NCSU
1993 - 1997	Associate Professor, Department of Botany, NCSU
1993 - present	Affiliate Professor, Department of Marine, Earth and Atmospheric Sciences (MEAS), NCSU
1986 - 1992	Assistant Professor, Department of Botany, NCSU
1982 - 1986	Graduate Research Assistant, Michigan State University (W.K. Kellogg Biological Station), Hickory Corners, MI
1981 (fall)	Instructor, *Introductory Chemistry* (for science majors), Quinebaug Valley Community College, Danielson, CT
1979 - 1980	Instructor of *Marine Botany*, summers, St. Georges College Prep. School, Newport, RI
1978 - 1981	Graduate Research Assistant and Graduate Teaching Assistant, Department of Botany, University of Rhode Island, Kingston, RI
1976 - 1977	Environmental Scientist, EcolSciences, Inc., Rockaway, NJ
1974 - 1975	Undergraduate Research Assistant, Limnology Laboratory, Department of Zoology, Iowa State University, Ames, IA

Awards and Distinctions

2009	Borlaug Joint Award for Service to the Environment and Society, College of Agriculture and Life Sciences/ College of Natural Resources, NCSU

2008	William Neal Reynolds Distinguished Professor, College of Agriculture and Life Sciences, NCSU, for excellence in research
2008	J. Compton River Achievement Award, River Network, lifetime achievement for leadership in research to advance water quality protection
2007	Darbaker Prize, Botanical Society of America, for excellence in research
2004	Fellow, American Association for the Advancement of Science (AAAS)
2003	Honorary Doctorate, Knox College, Galesburg, IL
2003	Provasoli Award, best paper of 2002, *Journal of Phycology*
2001	Honorary Doctorate, Southampton College - Long Island University
2000	Fellow, Aldo Leopold Leadership Program, Ecological Society of America
1999	Hutner Award, Society of Protozoologists, for excellence in microalgal research
1998	Scientific Freedom and Responsibility Award, AAAS
1998	Distinguished Service in Environmental Education Award, Environmental Educators of North Carolina
1998	Distinguished Scholarly Achievement Award, NCSU Honors Convocation
1998	Conservationist of the Year Award, National Wildlife Federation
1998	Conservationist of the Year Award, Governor of North Carolina and the North Carolina Wildlife Federation
1998	Jack Bayless Award – outstanding presentation of the year, South Carolina Fishery Workers Association, and the North and South Carolina chapters of the American Fisheries Society
1997	Admiral of the Chesapeake Award, Federal and State Leadership Summit, Washington, DC
1997	Outstanding Achievement Award, Society of Business and Professional Women of North Carolina
1997-2000	Pew Fellow in Marine Conservation, the Pew Foundation
1994	Outstanding Research Award, NCSU Alumni Association

Honors to the NCSU CAAE

2013	The CAAE was recognized as the reason why NCSU placed 31st among the top 50 "Colleges Saving the World" (http://www.onlinecollegesdatabase.org/50-colleges-saving-the-planet).
2012	The CAAE received the highest evaluation possible (Excellent) by an outside Peer Review Panel that reviewed in detail the Center's performance over its entire 14 years of operation. The panel was organized by the NCSU College of Agriculture and Life Sciences, as required by the UNC Board of Governors.

Other Honors

2013	Invited presentation on Harmful Algae - Capital Hill Briefing, representing the Coastal and Estuarine Research Federation
2007	Theodore L. Jahn and Eugene C. Bovee Award, International Society of Protozoologists, for best graduate student research paper, to doctoral candidate Hayley Skelton (coauthors of the paper, Burkholder and Parrow)
2001	Elected member, Alumni Hall of Fame, Rock Valley College, Rockford, Illinois
2001	Convocation speaker, Appalachian State University
2001	Convocation speaker, Southampton College - Long Island University
1998	Special recognition for excellence in research, Phi Kappa Phi
1998	Invited testimony, Congressional Hearing on the Value of Estuaries, US Senate, Senate Environment and Public Works Committee
1998	Invited testimony, Congressional Hearing on Harmful Algal Blooms, US Senate, Committee on Commerce, Science and Transportation

1997	Invited testimony, Congressional Hearing on Fisheries Conservation, Wildlife and Oceans, US House of Representatives – Committee on Resources
1997	Invited testimony, Congressional Hearing on Harmful Algae and Human Health, US House of Representatives – Committee on Government Reform and Oversight
1997-1999	Science Advisor, Governor's Commission on *Pfiesteria*, Maryland
1993-1994	Member, North Carolina Coastal Futures Committee (governor-appointed)
1993-1995	Member, Board of Directors, Partnership for the Sounds (directive, environmental education for eastern North Carolina)
1992-1997	Member-at-large, North Carolina Marine Fisheries Commission (governor-appointed)
1985	Elected member, Phi Kappa Phi, Michigan State University
1984-1986	Graduate fellow, Department of Botany and Plant Pathology, Michigan State University

Selected Research Accomplishments

(with thanks to my graduate students, postdoctoral research associates and other research associates, and collaborators)

Freshwater Ecosystems

- First to maintain automated platform stations with depth profiling capability for advanced research and monitoring of North Carolina reservoirs; the real-time data from these stations is also helping to safeguard drinking water supplies depended upon by more than half a million people.
- Experimentally quantified interactions between nutrient and sediment loadings in controlling noxious algal blooms in turbid reservoirs.
- First to document widespread occurrence, at low levels, of cyanotoxins in major potable water supplies in North Carolina.
- Documented novel nutritional and physical adaptations of a cryptic group of dinoflagellates in reservoirs affected by episodic suspended sediment loading.

Estuarine and Marine Ecosystems

- Discovered that water-column nitrate enrichment from sewage and other sources inhibits *Zostera marina*, the dominant seagrass of north temperate U.S. waters, as a direct physiological effect.
- Co-discovered the toxic dinoflagellates, *Pfiesteria piscicida* and *P. shumwayae*, as causative agents of major estuarine fish kills; this research also led to colleagues' discovery of a group of *Pfiesteria* toxins, new to science, that may be helpful in understanding human memory disorders.
- First to design and maintain a series of automated platform stations for advanced research and monitoring of a North Carolina estuary; coauthor of a patent for an automated depth profiler.
- First to show that shallow lagoonal estuarine ecosystems are resilient to the adverse effects of hurricanes, recovering within 4-5 years.
- Helped to develop a model for water mass transport to the Neuse Estuary; used the model and a detailed dataset for improved quantification of nutrient loads, including decadal trend analysis.

Publications (Peer-reviewed, in scientific journals, books and symposia volumes)

1) Burkholder JM, Bachmann RW (1979) Potential phytoplankton productivity in three Iowa streams. *Proceedings of the Iowa Academy of Sciences* 86: 22-25.

2) Sheath RG, Burkholder JM (1983) Morphometry of *Batrachospermum* populations intermediate between *B. boryanum* and *B. ectocarpum* (Rhodophyta). *Journal of Phycology* l9: 324-331.

3) Burkholder JM, Sheath RG (1984) The seasonal distribution, abundance and diversity of desmids (Chlorophyta) in a softwater, north temperate stream. *Journal of Phycology* 20: 159-172.

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comparative systems. *Reviews in Fisheries Science* 19: 358-417.

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158) Hathaway JM, Moore TLC, Burkholder JM, Hunt WF (2012)Temporal analysis of stormwater SCM effluent based on harmful algal bloom (HAB) sensitivity in surface waters: Are annual nutrient EMCs appropriate during HAB-sensitive seasons? *Ecological Engineering* 49: 41-47.

159) Burkholder JM, Glibert PM (2013) Eutrophication and oligotrophication, pp. 347-371. In: *Encyclopedia of Biodiversity*, 2nd edition, Volume 3, by Levin S (ed.). Academic Press, Waltham, MA.

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Technical Reports (peer-reviewed)

United States Department of Environmental Protection (U.S. EPA) (2011) *Efficacy of Ballast Water Treatment Systems: A Report by the EPA Science Advisory Board (SAB)*. U.S. EPA SAB Ecological Processes and Effects Committee Augmented for the Ballast Water Advisory. Report #EPA-SAB-11-009. U.S. EPA, Washington, DC, ~150 pp. Burkholder was an Augmented Panel Member and a coauthor of this report.

Burkholder JM (2010) *Assessment of Water Resources and Watershed Conditions in the Kennesaw Mountain National Battlefield Park, Georgia.* Draft Report to the Southeast Coast Inventory and Monitoring Network of the National Park Service, Southeast Regional Office, Atlanta, GA, 71 pp.

Burkholder JM, Allen EH, Kinder CA (2010) *Assessment of Water Resources and Watershed Conditions in Ocmulgee National Monument, Georgia*. Natural Resource Report NPS/SECN/NRR—2010/276. National Park Service, Fort Collins, CO, 81 pp.

Burkholder JM, Allen EH, Kinder CA, Morris E (2010) *Assessment of Water Resources and Watershed Conditions in the Chattahoochee River National Recreation Area, Georgia*. Draft Natural Resource

Report NPS/SECN.NRR-2010/274. National Park Service, Fort Collins, CO, 202 pp.

Burkholder JM, Rothenberger MB (2010) *Assessment of Water Resources and Watershed Conditions in Horseshoe Bend National Military Park, Alabama.* Natural Resource Report NPS/SECN.NRR-2010/268. National Park Service, Fort Collins, CO, 51 pp.

Burkholder J, Glasgow H, Deamer N, Melia G, Litzenberger T (2003) *Response of* Pfiesteria piscicida, *Microbial Predators and Prey, and Fish to Common Dithiocarbamate Fungicides and Heavy Metals*. Final Report to the U.S. EPA, Research Triangle Park, NC, 26 pp. + appendix.

Burkholder JM, Glasgow HB, Rublee PA, Shumway SE (2001) *The Toxic Dinoflagellate,* Pfiesteria, *as a Potential Biosensor of Estuarine Stress.* Final Report to the U.S. EPA, Washington, DC, 108 pp.

van der Schalie WH, Shedd T, Widder M, Kane AS, Reimschussel R, Sarabun J, Burkholder J, Glasgow H (2001) *Real-Time Monitoring for Toxicity Caused by Harmful Algal Blooms and Other Water Quality Perturbations*. Report EPA/600/R-01/103, U.S. EPA, Washington, DC.

Touchette BW, Burkholder JM, Glasgow HB (2001) *Distribution of American Water Willow (*Justicia americana *L.) in the Narrows Reservoir.* Final Report to Alcoa Power Generating Inc., Badin, NC, 51 pp.

Burkholder JM, Glasgow HB (1999) *Neuse Estuary Biomonitoring Study, with Additional Information on Overall Nutrient Loading to the Mesohaline Estuary*. Final Report to the U.S. Marine Air Station – Cherry Point. Department of Botany, NCSU, Raleigh, 134 pp.

Burkholder JM (1999) *The Role of Toxic* Dinoflagellates *in Fish Lesions*. Issue paper prepared for the U.S. Army. Office, Assistant Secretary of the Army - Installations, Logistics and Environment. Pentagon, Washington, DC.

Burkholder JM (1998) *The Toxic* Pfiesteria *Complex: A Scientific Discussion of its History, Ethology, and Impacts on Human Health.* Office, Assistant Secretary of the Army - Installations, Logistics and Environment. Pentagon, Washington, DC.

Burkholder JM, Glasgow HB, Deamer-Melia N (1998) *Neuse Estuary Biomonitoring Study – Physical, Chemical, and Biological Characteristics of Water Samples Collected from the Neuse Estuary in the Vicinity of Cherry Point, North Carolina, May 1993 - April 1998.* Final Report of a five-year study, to the U.S. Marine Air Station, Cherry Point, NC. Aquatic Botany Laboratory, NCSU, Raleigh, 110 pp.

Burkholder JM, Glasgow HB, Fensin E (1996) *Neuse Estuary Biomonitoring Study – May 1993 – December 1995.* Report of the first three years of a five-year study, to the U.S. Marine Air Station – Cherry Point, Cherry Point, NC. Aquatic Botany Laboratory, NCSU, Raleigh, 86 pp.

Burkholder JM, Parsons JE (1993) *Sediment and Phosphorus Loading: Predicting Water Quality in Urban Piedmont Reservoirs.* Report No. 274. UNC Water Resources Research Institute, Raleigh, NC, 194 pp.

Non-Referred and Popular Press Articles

Burkholder JM (2006) A major potable water supply reservoir poised for increased cyanobacteria blooms. *LakeLine* (summer), pp. 49-51.

Burkholder JM (2003) Science and the press. On-line modules (editor, N. Kriesberg), NCSU, Raleigh.

Schmechel DE, Burkholder JM, Attix DK, Glasgow HB (2002) Toxic *Pfiesteria*. Microbiology No. MB 02-5 (MB-036). *Check Sample, American Society for Clinical Pathology* 45:65-88.

Burkholder JM (2000) Brushstrokes from Floyd, pp. 72-79. In: *Eye of the Storm – Essays in the Aftermath*, by E.W. Rickert (ed.). Coastal Carolina Press, Wilmington.

President's Committee of Advisors on Science and Technology (PCAST) (1998) *Teaming with Life: Investing in Science to Understand and Use America's Living Capital.* Section I: Make Use of Current Knowledge in Managing Biodiversity and Ecosystems of the U.S., p.27. PCAST Panel on Biodiversity and Ecosystems, Washington, DC.

Burkholder JM (1997) *Pfiesteria* and Nutrient Pollution. Requested by Maryland's Governor Glendening for a summit meeting of five governors of states in the Chesapeake Bay watershed, Annapolis, pp. 1-5.

Burkholder JM (1995) Fish kills' message: Get serious about reducing nutrient over-enrichment to our estuaries, pp.1-3. In: *WaterWise*, by Doll B (Ed.). Vol. 1, 2nd Quarter. NC Sea Grant News Letter, Raleigh.

Coastal Futures Committee (1994) *Charting a Course for our Coast - A Report to the Governor of North Carolina.* L.R. Preyer, Chair. NC Department of Environment, Health and Natural Resources, Raleigh, 106 pp. [As the only scientist on the 15-member committee, I contributed substantially to all sections related to water quality, habitat, and fisheries in the document, and to the executive summary of prioritized recommendations.]

Burkholder JM (1993) Vital grasses need clean water to grow. In: *Currents*, News Letter of the Pamlico-Tar River Foundation, Vol. 13, Fall, p.7, Washington (NC).

Burkholder JM (1993) A newly discovered toxic alga and its relationship to fish kills, pp.48-58. In: *Proceedings from the Second North Carolina Marine Recreational Fishing Forum.* NC Sea Grant Report UNC-SG-93-06. UNC Sea Grant, NCSU, Raleigh, 61 pp.

Burkholder JM (1993) Golf course runoff: View from below the water surface, pp. 18-23. In: *Is Golfing Green? The Impact of Golf Courses on the Coastal Environment*. Symposium Proceedings (sponsored by the NC Coastal Federation and the NCSU Cooperative Extension Service through the NC Sea Grant College Program), Wilmington.

Patent

U.S. Patent #7,040,157. "Variable depth automated dynamic water profiler", Reed, Glasgow, Burkholder, Toms, May 2006 (NCSU; patent sold to YSI, Inc.).

Professional Activities

Editorial

Guest Co-Editor, special issue, *Harmful Algae* (Intraspecific Variation, 2009)
Guest Co-Editor, special issue, *Harmful Algae* (Harmful Algae and Eutrophication), 2007
Guest Co-Editor, special issue, *Harmful Algae* (Ecology of *Pfiesteria*), 2006
Editorial Board, *Journal of Experimental Marine Biology and Ecology*, 2005 - present
Editorial Board, *Harmful Algae,* 2002 - present
Editorial Board, *Journal of Eukaryotic Microbiology*, 1996-1999
Editorial Board, *Journal of Phycology*, 1995-1997

Other Society Service

Member, Organizing Committee, International Symposium on Harmful Algae, 2009-2010
Member, Organizing Committee, National Symposium on Harmful Algae, 2000, 2002, 2003
Member, Ethics Committee, American Society of Limnology and Oceanography, 1996-1997
Member, Harmful Algae Technical Advisory Committee, Maryland Department of Natural Resources, 1998-2001
Session Chair, Ecology of Aquatic Protozoa session, XIth Meeting of the International Congress of

Protozoology, 2001
Session Chair, New Harmful Algae, 10th International Conference on Harmful Algal Blooms, 2000
Session Chair, *Pfiesteria* in the Southeast, 1st National Symposium on Harmful Algae, 2000
Session Chair, Harmful Algae, 15th Biennial International Conference of the Estuarine Research Federation, 1999
Session Co-Chair, Harmful Algal Blooms, Annual Summer Meeting of the American Society of Limnology and Oceanography, 1998
Session Co-Chair, Harmful Algal Blooms, Joint Meeting of the American Society of Limnology and Oceanography and the American Geophysical Union, 1997
Chair, Hutchinson Award Committee, American Society of Limnology and Oceanography, 1996
Board of Directors, American Society of Limnology and Oceanography, 1994-1997
Session Chair, Ecology of Freshwater Algae, Joint Meeting of the International Phycological Congress and the Phycological Society of America, 1991
Session Chair, Phytoplankton, Annual Meeting of the American Society of Limnology and Oceanography, 1988

External Panels and Reviews

Member, panel review of the South Florida Environmental Report for the South Florida Water Management District, 2006, 2007, 2008, 2009, 2010, 2011
Examiner ("Opponent") of doctoral candidate Johannes Hagstrőm, Kalmar University, 2006
Member, review team for the Department of Botany, Miami University of Ohio, 2005
Member, review team for the Marine Sciences Programs, Institut für Meereskunde, Salzau, Germany, 1998
National Science Foundation, Biological Oceanography Panel, 1995
UNC Water Resources Research Institute Panel, 1991-1993
Member, review team, Lake Okeechobee Ecosystem Project, South Florida Water Management District, 1991

Workshops (Invited Participant)

The Importance of Algal Mixotrophy in Trophic Models of the Oceans – participant and invited speaker of an international workshop sponsored by the Leverhume Foundation, University of Maryland - Horn Point, Cambridge, MD, 2013
Taxonomy and Ecology of Algae in the Southeast – co-organizer of a workshop for members of the North Carolina Lake Management Society (NALMS – Southeast Chapter), sponsored by NALMS, 2009, 2010, 2011, 2012
Falls Lake Symposium: Christian Creation Stewardship – keynote speaker of a workshop attended by scientists and theologians, to encourage church memberships to become involved in environmental stewardship of the Falls Lake potable water supply, sponsored by the concerned citizens group, Wake Up Wake County, and organized by Drs. Bob George (editor, Theoecology Journal online) and Bruce Little (Center for Faith and Culture, Southeastern Theological Seminary), 2012
Algae Affecting Potable Water Supplies – AWWA, Savannah, GA, 2010
Identifying Harmful Cyanobacteria in North Carolina Potable Water Supplies – Organizer; two workshops for potable water treatment plant operators, sponsored by the NC Department of Health and Human Services, 2006
Occurrence of Toxigenic Cyanobacteria in the USA, International Symposium on Harmful Cyanobacterial Blooms, US Environmental Protection Agency (EPA), 2005
National Plan for Harmful Algal Research, Ecological Society of America and the National Oceanic and Atmospheric Administration (NOAA), 2004
Social and Environmental Impacts of Concentrated Animal Feed Operations, The University of Iowa and the National Institute of Environmental Health Sciences (NIEHS), 2004

Conflicted Science / Integrity in Science Conference and Workshop, Center for Science in the Public Interest, Washington, DC, 2003
Estuarine Fish Disease, Delaware Department of Natural Resources & Environmental Control, 2000
Harmful Algae Technical Advisory Committee Workshop, Maryland Department of Natural Resources (MD DNR) and Maryland Department of Environment (MD DE), 2000, 2001, 2002
Re-evaluation of Microbial Water Quality: Powerful New Tools for Detection and Risk Assessment, American Academy of Microbiology, 2000
Conservation Medicine Workshop, Center for Conservation Medicine of Tufts University, 1999
Harmful Algal Blooms: Research and Monitoring Programs, US EPA - Region IV, 1998
Pfiesteria Workshops - Sampling and Identification (organizer), NCSU, 1998
Pfiesteria Sampling and Identification Protocols, Centers for Disease Control & Prevention, 1998
European Harmful Algal Blooms (EUROHAB) Science Initiative, Marine Science and Technology Programme of the European Commission, 1998
Pfiesteria and Water Quality Monitoring Standards Workshop, NOAA, 1998
Pfiesteria and Human Health Workshop, Maryland Department of Health and Mental Hygiene and the Maryland Medical Team, University of Maryland and Johns Hopkins, 1998
State/Federal *Pfiesteria* Working Group - Monitoring Protocols, U.S EPA and NOAA, 1998
Maryland Technical Advisory Committee Workshop on *Pfiesteria*, Fish Kills and Water Quality Monitoring, MD DNR, Baltimore, MD, 1998
Pfiesteria Workshop, 14th Biennial International Conference of the Estuarine Research Federation, Providence, RI, 1997
The Cambridge *Pfiesteria/*Nutrients Workshop, convened by Governor Glendening of Maryland, 1997. The final report, *The Cambridge Consensus,* was used by the governor and the Maryland legislature to change policy about non-point water pollution control in tributaries to Chesapeake Bay and led to passage of the Maryland Water Quality Act of 1998.
Impacts of Toxic *Pfiesteria*/*Pfiesteria*-like Dinoflagellates on Fisheries and Human Health, US EPA (Philadelphia, PA; Washington, DC; Pensacola, FL), 1997; Delaware Department of Environment and Water Resources, 1997
Harmful Algal Blooms and Human Health, NIEHS, 1997
Pocomoke River Fish Disease, MD DNR, 1997
Climate Variability and Human Health, American Society of Microbiology, 1997
Developing an Environmental Education Video on Water Resource Issues in North Carolina, Z. Smith Reynolds Foundation, 1997
Control of Blue-Green Algae in Rainbow Springs, Florida, Department of Fisheries and Aquaculture, University of Florida, 1996
Sustainable Marine Fisheries, National Academy of Sciences Ocean Studies Board, 1996
Disease Events and Meteorology along the US Atlantic Coast, Harvard Medical School, 1995
National Nutrient Assessment Workshop – Estuaries, US EPA, Washington, DC, 1995
Harmful Algal Blooms - Research Initiative Development, NSF / NOAA, 1994
Seagrasses and Eutrophication Impacts, US EPA / Sarasota Bay National Estuary Program, 1993
Techniques in Sampling and Identification of *Pfiesteria* – NOAA, 1992; Florida Department of Environmental Protection - Florida Marine Research Institute, 1992; MD DNR, 1993; MD DE, 1993; Delaware Division of Water Quality, 1993
Target Issues: Development of RFP guidelines for a New NOAA Coastal Ocean Program Initiative on Harmful Algal Blooms, NOAA, 1992
Phytoplankton of the Southeastern United States, North Carolina Department of Environment, Health and Natural Resources (NC DEHNR) and Duke Power Company, 1992
Target Issues for Funding Support of Research on Toxic Phytoplankton, NOAA, 1992
Improved Data Base and Optimal Approaches for Modeling Water Quality in the Albemarle-Pamlico

Estuarine System, US EPA and NC DEHNR, 1992
Water Quality Regulations for Protection of Seagrass Habitat on the Gulf Coast, US EPA, 1992
Improved Standards for Protecting Water Quality in the Albemarle-Pamlico Estuarine System, US EPA, 1991
Teaching Aquatic Botany to High School Students (organizer), NCSU, 1987, 1988
Light Microscope-Autoradiography of Microalgae (organizer), Bowling Green State University, Bowling Green, OH, 1987

Grants (past decade)

Support for research and education outreach in aquatic sciences has been obtained from the National Science Foundation, the National Park Service, the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the U.S. Department of Defense, the Burroughs Wellcome Fund, the Park Foundation, the Z. Smith Reynolds Foundation, and the North Carolina Clean Water Management Trust Fund.

Research Presentations

Water Quality (Eutrophication, Seagrasses, etc.)

<u>2014</u>
Unprecedented Toxin-Producing Cyanobacterial Blooms in the Cape Fear River (Mallin et al., presentation and published abstract), Summer Meeting of the Sciences of Limnology and Oceanography.

<u>2013</u>
Outside Peer Review of the Marine Programs of the UNC System for the UNC Board of Governors, Morehead City, NC - The NCSU CAAE (Burkholder) was later given an excellent evaluation by the Panel in its final report.
Coastal and Estuarine Research Federation, San Diego, CA - Onset of unprecedented toxin-producing cyanobacteria blooms in the Cape Fear River system, North Carolina - Mallin MA., Burkholder JM, McIver MR, Metheny JD, Strangman WK, Zimba PV, Wright JL (presentation, with published abstract).
Coastal and Estuarine Research Federation, San Diego, CA - Comparative ecotoxicology of an agricultural herbicide on benign and toxigenic estuarine phytoplankton - Flood S, Burkholder J, Cope G. (poster, with published abstract).

<u>2012</u>
UNC Water Resources Research Institute, Raleigh, NC – The NCSU Center for Applied Aquatic Ecology Falls Lake Monitoring and Research Program - Burkholder J, Reed R, Kinder C, Allen E, James J, Mackenzie L (poster, with published abstract)
Falls Lake Creation Care Symposium, Wake Forest, NC - Status of Water Quality in Falls Lake - J. Burkholder. The goal of this national symposium was for scientists to inform theologians about citizens' potential roles, including church congregations, in assisting with natural resource stewardship issues (keynote presentation, with published abstract)

<u>2011</u>
UNC Water Resources Research Institute, Raleigh, NC (excessive ammonium concentrations throughout the Falls Lake water column, and implications for the Falls Lake Rules - with published abstract)
American Water Works Association National Webinar, online technology used to monitor algae and associated environmental conditions (invited, with published abstract)
LOICZ Open Science Conference 2011 – Coastal Systems, Global Change and Sustainability, Yantai, China (Shumway SE, Burkholder JM: mitigating coastal eutrophication – are filter-feeding shellfish the answer?) (plenary, with published abstract)

2010

UNC Water Resources Research Institute, Raleigh, NC (status of water quality in the most important potable water supply in North Carolina - with published abstract)

2009

National Shellfisheries Association, Savannah, GA (bivalve shellfish aquaculture and eutrophication)
North Carolina Academy of Science, Warren Wilson College, Swannanoa, NC (documenting microbial changes in reservoirs using metagenomics – coauthor)
Department of Civil and Environmental Engineering, Northwestern University, Chicago, IL (decadal analysis of land use, water quality, and phytoplankton assemblages in a coastal watershed)
20th Biennial Conference of the Coastal and Estuarine Research Federation (increasing ammonium in eutrophic estuaries, and its potential importance in governing phytoplankton assemblages)

2008

Department of Occupational and Environmental Health, U IA (water quality and algal blooms in watersheds influenced by industrialized agriculture)
NOAA National Symposium on Shellfish and the Environment, Warwick, RI (chronic effects of eutrophication on shellfish)
American Society of Limnology and Oceanography, St. Johns, Newfoundland, Canada (microdynamics of physical/chemical structure in a lagoonal estuary - lead, R. Reed; with published abstract)
North Carolina Water Quality Monitoring Forum, Charlotte (recent advances in technology for tracking algal blooms and related environmental conditions; with published abstract)

2007

Horn Point Environmental Laboratory, U MD (chronic eutrophication of the Neuse Estuary)
UNC Water Resources Research Institute, Raleigh (CAAE's Falls Lake Monitoring and Research Program; with published abstract)
UNC Water Resources Research Institute, Raleigh (groundwater and benthic nitrogen flux in the Neuse Estuary - lead, K. Null; poster with published abstract)
UNC Water Resources Research Institute, Raleigh (long-term impacts of changing land use practices on water quality and phytoplankton assemblages in the Neuse River ecosystem - lead, M. Rothenberger; poster with published abstract)
Annual Conference of the North Carolina Academy of Science, Greenville (inorganic nitrogen flux across the sediment-water interface in the Neuse Estuary - lead, K. Null; poster with published abstract).
Conference, Water Initiatives: What's on the Horizon for Lake Users and Managers, Greensboro.
19th Biennial Conference of the Estuarine Research Federation, Norfolk, VA (temporal and spatial variability in high-resolution, cross-estuarine physical/chemical structure in the Neuse Estuary – lead, R. Reed; poster with published abstract).
19th Biennial Conference of the Estuarine Research Federation, Norfolk, VA (multivariate analysis of phytoplankton and environmental factors in a eutrophic estuary - lead, M. Rothenberger; poster with published abstract).

2006

Department of Biology, Cornell University (water quality trends in the Neuse Estuary)
Department of Marine Sciences, U CONN (water quality trends in the Neuse Estuary)

2005

Department of Biology, UNC Greensboro (water quality trends in the Neuse Estuary)
Wilkes Community College, Wilkesboro, NC (honors seminar series - water quality issues)

2003

Center for Science in the Public Interest: Conflicted Science Conference, Washington, DC (water quality

and confined animal feed operations [CAFOs] - with published abstract)
Yale University - Conference, The Chicken (environmental impacts of CAFOs - with published abstract)

2002

Medical School, Harvard University (marine diseases, anthropogenic influences)
Wilkes Community College, Wilkesboro (honors seminar series - water quality issues)

2001

Washington College (Chesterton, MD; environmental impacts of CAFOs)
Veterinary, Wildlife and Ecological Toxicology Department, Veterinary Biosciences College of Veterinary Medicine, U IL (national water quality issues)
School of Design, NCSU (environmental effects of CAFOs)
Wilkes Community College (honors seminar series - water quality issues)
American Society of Agronomy and the Soil Science Society of America (Northeast Branch) – annual meeting, URI (environmental effects of CAFOs; with published abstract)

2000

American Fisheries Society - annual meeting, St. Louis, MO (environmental effects of CAFOs – with published abstract).
American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America - joint meeting, Minneapolis, MN (nutrient management on CAFOs, and effects on surface water resources - with published abstract)
Association of Southeastern Biologists, Chattanooga, TN: Plenary Speaker (national water quality issues - with published abstract)
Rock Valley College - Natural Resources and Community Action Series, Rockford, IL: Plenary Speaker (national water quality issues)
U MASS, Amherst - Environmental Policy Seminar Series (invited; national water quality issues)
Yale University, School of Forestry (national and state water quality issues)
Department of Zoology, U WA - Seattle (national water quality issues)
American Fisheries Society (NC chapter), New Hill, NC (impacts of Hurricane Floyd on water quality in the Neuse River and Estuary, and Pamlico Sound - with published abstract)

1999

US Department of Agriculture - National Resources Conservation Service, Washington, DC (state water quality issues)
Simon Fraser University - Oceans Limited Conference, Vancouver, British Columbia, Canada (chronic effects of eutrophication - with published abstract)
Department of Biology, University of Louisville, Louisville, KY (chronic effects of eutrophication)

1998

Society of Environmental Toxicology and Chemistry - annual meeting, Charlotte, NC: Keynote Speaker (effects of chronic eutrophication - with published abstract)

1997

Conference, Nutrients in the Neuse River: Working Toward Solutions (sponsor, UNC Water Resources Research Institute [WRRI]), NCSU (effects of chronic eutrophication - with published abstract)

1996

National Association of Biology Teachers - annual meeting, Charlotte, NC (effects of chronic eutrophication - with published abstract)
Texas A&M University, Corpus Christi (effects of pulsed nutrient enrichment on seagrass physiology)
Department of Zoology, Oregon State University (OSU), Corvallis (seagrasses and eutrophication)

1995

Statewide Nutrient Summit (sponsors, NC Sea Grant, NC DEHNR), NCSU (effects of chronic eutrophication - with published abstract)

Water Quality Research and Extension Overview, College of Agriculture and Life Sciences (CALS), NCSU (surface water quality research in CALS - with published abstract)

1994

NC Academy of Sciences - annual meeting, Manteo - Keynote Speaker (state water quality issues - with published abstract)

1993

UNC WRRI Seminar Series, Keynote Accomplishments in Research on Water Resources in NC, Raleigh (seagrasses and water-column nitrate enrichment - with published abstract)

Horn Point Environmental Laboratory, U MD (seagrasses and water-column nitrate enrichment)

1992

UNC WRRI Seminar Series, Keynote Accomplishments in Research on Water Resources in NC (sediment and phosphorus loading: predicting reservoir water quality – with published abstract)

American Society of Limnology and Oceanography - annual meeting, Edmonton, Alberta, Canada (seagrasses and eutrophication - with published abstract)

1990

Department of Zoology, U WI - Madison (algal phototrophy *vs.* heterotrophy in turbid reservoirs)

1987

Department of Biology, Bowling Green State University, Bowling Green, OH (biological interactions that structure stream plant communities)

1986 (nutrient interactions - macrophytes, epiphytes)

Department of Botany, NCSU

Department of Biology, Fordham University, Bronx, NY

Savannah River Ecology Laboratory, Aiken, SC

University of Michigan Biological Station, University of Michigan, Pellston, MI

1985

Department of Biology, West Virginia University, Morgantown, WV - importance of benthic microalgae in stream ecosystems

Massachusetts Audubon Society, Lincoln, MA - effects of acid deposition on aquatic ecosystems

Harmful Algal Research

2013

Leverhume Foundation International Workshop, U MD - Horn Point, Cambridge, MD (algal mixotrophy and water-column nutrients)

2010

North American Lake Management Society (NALMS), Winston-Salem, NC (climate change and harmful algal blooms in the Southeast - with published abstract)

Webinar Lecture Series, Northwestern University, given at the University of British Columbia, Vancouver, BC, Canada (overview on harmful algae)

2008

Burdick Lecture, Department of Biology, Alfred University, Alfred, NY (*Pfiesteria*, other harmful dinoflagellates - toxicity, impacts)

Annual Toxicology and Risk Assessment Conference, Cincinnati, OH (the toxins of inland algae - with published abstract)

2007

Joint meeting of the Phycological Society of America and the International Society of Protozoologists (cyanobacteria in eutrophic turbid impoundments of the North Carolina Piedmont - lead, J. Burkholder; poster with published abstract)

Joint meeting of the Phycological Society of America and the International Society of Protozoologists (axenic cultivation of a heterotrophic dinoflagellate - lead, H. Skelton; with published abstract)

4th National Symposium on Harmful Algae, Woods Hole, MA (axenic cultivation of *Pfiesteria shumwayae* on a semi-defined medium; poster with published abstract)

2006

Kalmar University, Kalmar, Sweden (*Pfiesteria*, other harmful dinoflagellates - toxicity, impacts)

American Society of Limnology and Oceanography - annual summer meeting: Plenary Speaker, Victoria, British Columbia, Canada (stimulation of harmful algae by eutrophication – with published abstract)

2005

North American Lake Management Society (NALMS) - National Meeting, U WI - Madison – Keynote Speaker (cyanobacteria in potable water supplies - with published abstract)

GEOHAB (Global Ecology and Oceanography of Harmful Algal Blooms) Symposium, Nutritional Ecology of Harmful Algae, Baltimore, MD (importance of intraspecific variation – with published abstract)

Medical School, Harvard University (harmful algae and seafood safety)

NALMS Southeast Chapter Meeting, Asheville, NC (cyanobacteria in potable water supplies - with published abstract)

American Water Works Association - Source Water Protection Symposium, West Palm Beach, FL (cyanobacteria in potable water supplies - with published abstract)

2004

XIth International Conference on Harmful Algae, Cape Town, South Africa: Plenary Speaker (intraspecific variation in toxicity, behavior and nutrition - with published abstract)

St. Johns Water Management District, Orlando, FL (effects of harmful algae on fish and mammalian health)

International EnviroVet Program, Harbor Branch Oceanographic Institute, Fort Pierce, FL (marine diseases)

Department of Oceanography, U WA - Seattle (science, policy)

Shannon Point Marine Laboratory, Western Washington University (science, policy)

NSF Undergraduate Education Honors Program, NCSU (science, policy)

2003

Elon University - Voices of Discovery Seminar Series: Keynote Speaker (*Pfiesteria*)

International EnviroVet Program, Harbor Branch Oceanographic Institute (toxic dinoflagellates)

Florida Institute of Technology (toxic dinoflagellates)

Conference on Emerging Waterborne Pathogens, NC Department of Health and Human Services (DHHS), Wilmington, NC: Two presentations - toxic dinoflagellates; toxic cyanobacteria)

2002

Hopkins Marine Laboratory, Stanford University, Monterey, CA (*Pfiesteria*, other toxic dinoflagellates - science, policy, science ethics)

National Ocean Service, NOAA, Charleston, SC (progress in *Pfiesteria* research)

Symposium, Climate Change and Fisheries in the Gulf of Maine (sponsor, NOAA), College of the Atlantic, Bar Harbor, ME (harmful algae and climate change)

Department of Biology, UNH, Durham (toxic dinoflagellates).

Department of Biology, Williams College, Williamston, MA (toxic dinoflagellates)
Department of Biology, Miami University of Ohio, Athens (toxic dinoflagellates)

2001

XIth International Congress of Protozoology, Salzburg, Austria (dinoflagellates - complex life histories and feeding behaviors – with published abstract)
George Clark Lecture Series, Wetlands Institute, Cape May, NJ (*Pfiesteria*, other dinoflagellates)
Society for Risk Analysis, Research Triangle Park (biomarkers for species and toxins)
Environmental Lecture Series, Ashland University, Ashland, OH (harmful algae and eutrophication)
Marine Conservation Biology Series, Wheaton College, Springfield, MA (chronic effects of harmful algae on fish and mammalian health)

2000

IXth International Conference on Harmful Algal Blooms, Hobart, Tasmania, Australia: Plenary Speaker (toxic *Pfiesteria* - with published abstract)
Elliott-Nowell-White Symposium, Delta State University, Delta State, MS: Keynote Speaker (chronic and sublethal impacts of harmful algae on mammalian health)
Society of Toxicology of Canada - annual meeting, Montreal, Quebec, Canada (toxic dinoflagellates - with published abstract)
Department of Biology, State University of NY - Syracuse (toxic dinoflagellates)
Brookhaven National Laboratory, Brookhaven, NY (toxic dinoflagellates)
State University of New York - Stony Brook (toxic dinoflagellates)
XIIIth World Congress of the International Society of Toxinology, Paris, France (toxic *Pfiesteria*)
Centers for Disease Control & Prevention, Atlanta - conference, *Pfiesteria*: From Biology to Public Health (ecology and conservative analysis of role in fish kills - with published abstract)
National Association of Biology Teachers - Biotechnology Conference. VPI, Blacksburg (harmful algal research)
University of Mississippi, Oxford - Conference, Sustainability of Wetlands and Water Resources (toxic dinoflagellates)
Department of Biology, University of Memphis (toxic dinoflagellates)
Society of Microbiology - Northeast Chapter, Sturbridge, MA (toxic dinoflagellates)
Society of Toxicology - annual meeting (sponsor, US EPA), Philadelphia (toxic dinoflagellates - with published abstract)
Southeastern Estuarine Research Society - annual meeting in conjunction with the 29th Benthic Ecology Meeting and the annual meeting of the Atlantic Estuarine Research Society, Wilmington, NC (toxic dinoflagellates - with published abstract)

1999

National Academy of Sciences - Workshop on Critical Research Needs, Washington, DC (research needs to advance understanding about harmful algae)
Lake Biwa Research Institute, Forum on Water Quality, Kyoto, Japan: Keynote Speaker (*Pfiesteria*, other toxic dinoflagellates)
Woods Hole Oceanographic Institute, Falmouth, MA (toxic dinoflagellates)
Veterinary School, Tufts University, Grifton, MA (toxic dinoflagellates)
Department of Biology, Yale University (improved mitigation of harmful algal blooms)
Georgetown Conference on Policy and *Pfiesteria*, Georgetown University, Washington, DC: Keynote Speaker (science, policy of *Pfiesteria* - with published abstract)
American Association for the Advancement of Science (AAAS) - annual meeting, Anaheim, CA, session, “Human Health Risks in the Ocean” (chronic and sublethal impacts - with published abstract)
AAAS - annual meeting, Anaheim, CA, session “Harmful Algal Blooms” (toxic *Pfiesteria* - with published abstract)
Department of Geology, University of Oslo (Oslo, Norway) (toxic *Pfiesteria*)

Society of Protozoologists - annual meeting, Raleigh: Keynote Speaker (toxic *Pfiesteria* - with published abstract)
Department of Ecology Evolution and Behavior, U MN - Minneapolis (toxic dinoflagellates - with published abstract)
Phi Beta Kappa Seminar Series, Elon University (toxic *Pfiesteria*)
Honors Seminar Series, Southampton College, Southampton, NY (toxic dinoflagellates)
Department of Biology, Barton College, Wilson (toxic dinoflagellates)
Department of Biology, Davidson College, Davidson (toxic dinoflagellates)
Wilkes Community College, Wilkesboro (toxic dinoflagellates)
Department of Biology, NC A&T University, Greensboro (toxic dinoflagellates)
Department of Pathology, UNC Chapel Hill (toxic dinoflagellates)
Department of Biology, UNC Greensboro (toxic dinoflagellates)
Department of Biology, University of Louisville (toxic dinoflagellates)
Sigma Xi - NC Chapter meeting, Appalachian State University, Boone, NC (toxic *Pfiesteria*)

<u>1998</u>
AAAS - annual meeting, Philadelphia, session, “Management of Harmful Marine Microbes: When Science and Politics Don’t Mix” (harmful algae - with published abstract)
Medical School, Harvard University (harmful algae)
Shallow Water Conference (sponsor, US EPA), Atlantic City, NJ: Keynote Speaker (effects of toxic *Pfiesteria* on fish and mammals - with published abstract)
Gordon Conference - annual meeting, Ventura, CA (acute/chronic effects of toxic dinoflagellates - with published abstract)
Department of Biology, Rutgers University (chronic effects of toxic dinoflagellates)
Department of Biology, URI (toxic dinoflagellates)
Department of Pharmacology, U GA - Athens (toxic dinoflagellates)
American Biological Safety Association - 41st Annual Biological Safety Conference, Lake Buena Vista, FL: Eagleston Lecture (*Pfiesteria*, other toxic dinoflagellates - with published abstract)
Wildlife Disease Association - 47th Annual Conference, U WI - Madison (toxic *Pfiesteria* - with published abstract)
Department of Biology, Purdue University (toxic dinoflagellates)
American Institute of Biological Sciences - 49th annual meeting (toxic dinoflagellates - with published abstract)
Microbiology Society of NC - annual meeting, Research Triangle Park: Keynote Speaker (*Pfiesteria*, other toxic dinoflagellates)
NC Water Resources Association - Conference on Water Pollution Issues in NC, Asheville: Keynote Speaker (*Pfiesteria*, other toxic dinoflagellates - with published abstract)
Northeast Algal Symposium - annual meeting, Plymouth, MA – Keynote Speaker (toxic *Pfiesteria* - with published abstract)
American Society of Limnology and Oceanography - joint summer meeting with the Ecological Society of America, Symposium Session Honoring Minority Students: Keynote Speaker (*Pfiesteria*, other harmful algae – with published abstract)
Stanford University, Institute of Ecosystem Ecology (toxic *Pfiesteria*)
NASA, Goddard Space Center, Baltimore, MD (*Pfiesteria*, other toxic dinoflagellates)
Keynote Seminar Series in Marine Sciences, Wilmington, DE (sponsors, U DE, DE Sea Grant): Presentation (*Pfiesteria*)
Friends of the Library, NCSU (*Pfiesteria*, other toxic dinoflagellates)
Department of Biology, Auburn University (toxic dinoflagellates)
Department of Environmental Sciences, Drexel University, Philadelphia (toxic *Pfiesteria*)
Department of Biology, Hampden Sydney College, Hampden-Sydney, VA (toxic dinoflagellates)

Department of Biology, UNC Charlotte (*Pfiesteria*, other toxic dinoflagellates)
Headquarters, US EPA, Washington, DC (toxic *Pfiesteria*)
Distinguished Lecturer Series, Old Dominion University, Norfolk, VA (*Pfiesteria*)

<u>1997</u>
Society for Conservation Biology - annual meeting, Victoria, British Columbia, Canada (harmful algae and eutrophication - with published abstract)
Department of Biology, University at Buffalo, Buffalo, NY (*Pfiesteria*, other toxic dinoflagellates)
Departments of Zoology and Oceanography, OSU (toxic algae)
3rd Annual Conference on Population-Level Effects of Marine and Estuarine Contamination, Charleston, SC (science, policy - with published abstract)
Wagner College, Staten Island, NY (special college-wide seminar, toxic *Pfiesteria*)
Department of Biological Science, Florida State University, Tallahassee (toxic dinoflagellates)
Department of Botany, Duke University (*Pfiesteria*, other toxic dinoflagellates)
Conference on Fisheries, Habitat and Pollution (sponsors, SC Sea Grant, TerrAqua Environmental Science and Policy Institute), Charleston, SC (chronic and sublethal effects of harmful algae - with published abstract)
Institute of Ecosystem Studies, Millbrook, NY (chronic and sublethal effects)
American Fisheries Society, NC Chapter - annual meeting, Lake Wylie, SC (*Pfiesteria* - with published abstract)

<u>1996</u>
AAAS - annual meeting, session Global Change and Emerging Infectious Diseases (effects of harmful algae on fish and mammalian health - with published abstract)
NATO Workshop, Physiological Ecology of Harmful Marine Phytoplankton, Bermuda Biological Station for Research (raptorial dinoflagellates - with published abstract)
Sigma Xi - UNC Greensboro and NCCU Chapters: Keynote Speaker (toxic *Pfiesteria*)
Department of Biology, Southampton College, Long Island University, Southampton, NY (toxic dinoflagellates)
Department of Biology, University of Cincinnati, Cincinnati (toxic dinoflagellates)
NIEHS, Research Triangle Park (toxic *Pfiesteria*)
Whitney Laboratory, U FL - St. Augustine (toxic dinoflagellates)
Department of Biology, Wake Forest University, Winston-Salem (toxic dinoflagellates)
Association of Women in Science, UNC Chapel Hill (*Pfiesteria*, other toxic dinoflagellates)
Texas A & M University, Corpus Christi, TX (*Pfiesteria*, other toxic dinoflagellates)

<u>1995</u>
Society of Protozoologists - annual meeting, U AL, Tuscaloosa, AL: Keynote Speaker (toxic *Pfiesteria* and its microbial, macroinvertebrate and vertebrate prey - with published abstract)
5th Pan American Symposium on Animal, Plant and Microbial Toxins, Baltimore, MD (*Pfiesteria* - with published abstract)
Department of Toxicology, NCSU (toxic dinoflagellates)
Department of Biology, U MD, Baltimore, MD (toxic *Pfiesteria*)

<u>1994</u>
First International Conference on Ecosystem Health and Medicine, Ottawa, Ontario, Canada (effects on human health - with published abstract)
E-MAP Monitoring Program, US EPA, Research Triangle Park (emerging toxic algae - effects on fisheries and public health)
Department of Biology, University of Richmond (emerging toxic algae)
Department of Environmental Health, Boston University (toxic dinoflagellates)
Department of Biology, SUNY - Stony Brook (toxic dinoflagellates)
International Society for Evolutionary Protistology - Biennial Meeting, Halifax, Nova Scotia, Canada: Keynote Speaker (*Pfiesteria* and its prey - with published abstract)

Institute of Ecology, U GA - Athens (harmful heterotrophic dinoflagellates)
Department of Fisheries and Aquaculture, U FL - Gainesville (toxic dinoflagellates)

1993

Fifth International Conference on Modern and Fossil Dinoflagellates (Zeist, the Netherlands): Keynote Speaker (toxic *Pfiesteria* - with published abstract)
Beta Beta Beta Biological Honors Society, Elon University: Keynote Speaker (effects of toxic *Pfiesteria* on estuarine food webs)
Chesapeake Biological Laboratory, Solomons, MD (toxic dinoflagellates)
Southeastern Fisheries Society, Reidsville, NC (toxic dinoflagellates and fish health)
Dauphin Island Marine Laboratory, Dauphin Island, AL (toxic dinoflagellates)
Department of MEAS, NCSU (*Pfiesteria*)

1992

Vth International Symposium on Toxic Algae, Newport, RI (toxic *Pfiesteria* - with published abstract)
Southeast Regional Directors of the Sea Grant College Program - annual meeting: Keynote Speaker (*Pfiesteria*)
Department of Zoology, NCSU (toxic *Pfiesteria*)
US Geological Survey, Raleigh (toxic *Pfiesteria*)
NC Statewide Phytoplankton Meeting, Duke Power Company (Huntersville, NC: Keynote Speaker (harmful dinoflagellates)
Department of Biology, UNC Wilmington (*Pfiesteria*, other toxic dinoflagellates)
Department of Biology, Appalachian State University, Boone, NC (toxic dinoflagellates)
Department of Biology, UNC Greensboro (toxic dinoflagellates)
US EPA, Narragansett, RI (*Pfiesteria*, other toxic dinoflagellates)
Department of Biology - Marine Sciences Group, UNC Chapel Hill (toxic dinoflagellates)
Bodega Marine Laboratory, U CA - Davis, Bodega Bay (toxic dinoflagellates)

Other Algae

2012

Phycological Society of America, Charleston, SC (Mixson, S. and J. Burkholder - enhancing lipid production in the marine microalga *Dunaliella* through environmental stressors - with published abstract)

2010

Webinar, Northwestern University special summer course for graduate students, given at the University of British Columbia, Vancouver, BC (the ecology of periphyton)

2007

Society of International Limnologists (SIL) - 30th Congress of the International Association of Theoretical and Applied Limnology, Montreal, Quebec, Canada (importance of benthic microalgae across freshwater, estuarine and marine ecosystems - with published abstract)

1999

Society for General Microbiology - Symposium, Microbial Signaling and Communication, University of Edinburgh, Edinburgh, Scotland (signaling in dinoflagellates - with published abstract)

1991

Department of Biology, VPI, Blacksburg, VA (phytoplankton survival of pulsed suspended sediment loading)

1990

Center for Reservoir Research, Hancock Biological Station, Murray State University, Paducah, KY (phytoplankton and periphyton dynamics in turbid, eutrophic reservoirs)

Department of Zoology, NCSU - Aquatic Ecology Seminar Series (mutualistic symbioses involving algae)
Department of MEAS, NCSU (role of benthic microalgae in eutrophication of freshwater and coastal marine habitats)

1989
Experimental Lakes Area (ELA), University of Manitoba, Winnepeg, Manitoba, Canada (relative importance of the water column and macrophytes as nutrient sources for epiphytes)
Hampton University, Hampton, VA (biotechnology in aquatic ecology)
Department of Biology, University of Louisville, Louisville, KY (use of autoradiography to examine nutrient dynamics of microalgal biofilms)
Duke Marine Laboratory, Beaufort (nutrients and epiphytes – unifying trends in freshwater and marine ecosystems)

1988
Department of Biology, UNC Chapel Hill - Marine Macroalgae Seminar Series (epiphytes)
Department of Biology, East Carolina University (phosphorus sources for epiphytic microalgae)
Department of Botany, Duke University (nutrient sources for epiphytic microalgae)
Environmental Section, Carolina Power and Light Company, New Hill, NC (epiphytic microalgae - role in nutrient cycling of lakes)

Science Ethics and Environmental Issues

2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014
Park Scholars Program, NCSU (role of science ethics in environmental issues)

2005
Department of Epidemiology, UNC Chapel Hill, Forum "Funding, Academic Freedom, and Public Responsibility" (industry and water quality)

2004
Department of Biology, Cornell University (toxic algae)
Department of Civil Engineering, NCSU (water quality)
Department of Biology, UNC Asheville (water quality)

2003
New York Metropolitan Association of College and University Biologists – 36th Annual Conference, Wagner College, Staten Island: Keynote address (role of science ethics in natural resource issues)
NSF Environmental Education Program, NCSU (toxic algae, water quality)

1999
Department of Geology, University of Oslo, Oslo, Norway (toxic algae, water quality)
Park Foundation Lecture Series, College of Journalism, UNC Chapel Hill (critical role of journalists in environmental science education and ethics)

1998
Metcalf Institute for Marine and Environmental Journalism - annual board meeting, URI: Keynote Speaker (how environmental journalists can help to strengthen science ethics)

Academic Contributions

Courses Taught

- PB 595A, *Aquatic Plant Ecology* (4 credits; 1987 - present, fall alternate years)

- PB 595W, *Environmental Issues in Aquatic Ecology* (3 credits, 1990 - present, usually fall alternate years) - special topics/current events graduate course
- PB/MB 774, *Phycology* (3 credits including laboratories; 1987 - present, spring alternate years)
- BO 595E, *Ecology, Evolution and Diversity* – (2003; course coordinator, Jon Stuckey); mini-course: designed and taught one of eight modules on aquatic vascular plants as bioinvaders
- PB 824C, *Plant Biology Colloquium* (1 credit) – co-taught with Nina Allen (spring 2002, 2004, 2006) or Bill Thompson (spring 2009, 2011, 2013); graduate students receive training to give presentations, write grant proposals, and critique grant proposals)
- HON 398, *Honors Seminar on Aquatic Ecology* (1 credit, spring 2008) – seminar/discussion course for undergraduate honors students on aquatic natural resource issues in North Carolina
- EMS 496/622/822 or TDE 490/610 – STEM Education Seminar Course, *Environmental Issues in Estuarine Ecology and Pedagogical Applications* (1 credit, spring 2010), co-taught with P. Simmons and A. Clark.

Guest Lectures (examples, past five years)

- PB 101, *Introduction to Plant Biology*, Department of Plant Biology, NCSU (once per year, 2006-2011)
- PB 250, *Plant Biology*, Department of Plant Biology, NCSU (2010, 2011)
- *Park Scholars*, NCSU (once per year, 2006-2011)
- Freshman Focus Program, “Science, Society, Uncertainty, and Conflicting Values” (Duke University, Durham, NC, 2010)

Major or Co-major Advisor of Graduate Students

Stacie Flood, Ph.D. (Plant and Microbial Biology, in progress, expected winter 2014)

Stephanie Mixson, Ph.D. (Plant & Microbial Biology [department name change] - 2013)
Thesis: *Dunaliella* spp. under environmental stress: Enhancing lipid production and optimizing harvest
Honor: Secured a grant to help support her dissertation research, from the Charles A. and Anne Morrow Lindbergh Foundation (2010)
Post-Graduate Position: Analytical Development Specialist, Medicago USA, Research Triangle Park (2013)

Eva Ngulo, M.A. (Plant Biology, 2011)
Final paper: Influence of clay treatment on noxious planktonic cyanobacteria

Kimberly Null, Ph.D. (MEAS; co-advisor with Dr. Dave DeMaster), 2010
Thesis: Ammonium dynamics in a shallow lagoonal estuary
Honors: Secured two grants to help support her dissertation research, from the NC Academy of Science (2006) and the Geological Society of America (2006)
Post-Graduate Positions: Post-Doctoral Research Associate, University of California - Santa Cruz, then Post-Doctoral Research Associate, East Carolina University - Greenville, NC (research in Antarctica)

Hayley Skelton, Ph.D. (MEAS; co-advisor, Dr. Dan Kamykowski), 2008
Thesis: Nutritional features and feeding behavior of the heterotrophic dinoflagellate, *Pfiesteria shumwayae*
Honor: Won the Theodore L. Jahn and Eugene C. Bovee Award for best graduate student research paper, annual meeting of the International Society of Protozoologists, Providence, RI (2007)
Post-Graduate Positions: Post-Doctoral Fellow, National Research Council, NOAA / University of Connecticut (2008), then Supervisor of Algal Culturing, Algenol Biofuels, Fort Myers, FL (2009)

Meghan Rothenberger, Ph.D. (Plant Biology), 2007
Thesis: Long-term impacts of changing land use practices on water quality and phytoplankton assemblages in the Neuse Estuary ecosystem, North Carolina
Honors: Won best graduate research presentation, Graduate Student Forum, Department of Plant Biology (2007)
Won best Ph.D. dissertation of the year (2007) at NCSU, from the NCSU Graduate School (2008)
Post-Graduate Positions: Post-Doctoral Associate, CAAE (Visiting Professor, UNC Greensboro; then assistant professor at Lafayette College, Easton, PA)

Susan Pate, M.S. (Botany), 2006
Thesis: Impacts of the toxic dinoflagellate *Alexandrium monilatum* on three ecologically important shellfish species
Post-Graduate Position: Laboratory Administrator (Biotechnology), Duke University

Matthew Parrow, Ph.D. (Botany), 2003
Thesis: Feeding, reproduction, and sexuality in *Pfiesteria* spp. and cryptoperidiniopsoid estuarine heterotrophic dinoflagellates
Honor: Won the Kellar Award for outstanding dissertation research (NCSU), 2004
Post-Graduate Positions: Post-Doctoral Associate, CAAE (now Assistant Professor, UNC Charlotte)

Paul Cancellieri, M.S. (Botany), 2001
Thesis: Chemosensory attraction of *Pfiesteria* spp. to fish secreta
Post-Graduate Position: Teacher, Durant Middle School, Raleigh

Howard Glasgow, Ph.D. (MEAS; co-advisor - main advisor, Dr. Dan Kamykowski), 2000
Thesis: Biology and impacts of toxic *Pfiesteria* complex species
Post-Graduate Position: Researcher, CAAE (permanently disabled by a neurological illness)

Jeffrey Springer, M.S. (MEAS; co-advisor, Dr. Dave Eggleston), 2000
Thesis: Interactions between two commercially important species of bivalve molluscs and the toxic estuarine dinoflagellate, *Pfiesteria piscicida*
Honor: Won the Best Student Presentation Award at the Annual Meeting of the National Shellfish Association, Seattle, WA, 2002
Post-Graduate Position: Research Associate, CAAE

Naomi Tsurumi, M.A. (Botany), 2000 Thesis: Influence of Industrialized Swine Agriculture on Air Quality
Post-Graduate Position: Environmental Policy M.A. program, Duke University

Brant Touchette, Ph.D. (Botany), 1999
Thesis: Physiological and developmental responses of eelgrass (*Zostera marina* L.) to increases in water-column nitrate and temperature
Post-Graduate Position: Assistant Professor, Elon University (now associate professor)

Elizabeth Fensin, M.S. (Botany), 1997
Thesis: Population dynamics of *Pfiesteria*-like dinoflagellates, and environmental controls in the mesohaline Neuse Estuary, North Carolina, USA
Post-Graduate Position: Research Assistant, North Carolina Department of Environment and Natural Resources (then called the North Carolina Department of Environment, Health, and Natural Resources)

L. Michael Larsen, Ph.D. (Zoology; co-advisor with Dr. Sam Mosley), 1995

Thesis: Responses of *Diaphanosoma brachyurum* (Cladocera: Suicide) and other zooplankton to clay loading and algal food quality in a turbid southeastern reservoir.
Post-Graduate Position: Assistant Professor, Campbell University, Fayetteville, NC (now Professor and Department Chair, Biology)

Leslie (Taylor) Taggett, M.S. (Botany), 1995
Thesis: Nitrate reductase activity of two intertidal macroalgae across gradients of temperature, salinity and desiccation
Post-Graduate Position: Research Assistant – Analytical Chemistry Laboratory, NC DEHNR

Virginia Coleman, M.S. (Botany), 1993
Thesis: Community structure and productivity of epiphytic microalgae on eelgrass (*Zostera marina* L.) under water-column nitrate enrichment
Post-Graduate Position: Research Associate – Algal Laboratory, NC Department of Environment and Natural Resources

Phumelele Gama, M.S. (Botany), 1992
Thesis: Phytoplankton response to a sediment loading gradient in a mesotrophic reservoir
Post-Graduate Position: Lecturer of Botany, University of Zululand, South Africa

Deborah Everitt (Tan), M.S. (Botany), 1992
Thesis: Seasonal dynamics of macrophyte communities from a stream flowing over granite flatrock in North Carolina, USA
Post-Graduate Position: Stream Scientist, MD Department of Natural Resources

Other Graduate Student Committee Memberships

Ph.D.
Stephanie Archer, Applied Ecology
Yini Shangguan, U MD (Center for Environmental Science)
Brett Hartis, Fisheries, Wildlife and Conservation Biology
Geoff Sinclair, MEAS
Diane Whitaker, Science Education
Katherine Galucci, Science Education
Daniel Dickerson, Science Education
Nancy White, Forestry
Louis Elsing, Forestry
Dennis Hazel, Forestry
Gary Kirkpatrick, Zoology
Francois Bergand, Biological and Agricultural Engineering
Leslie Dorworth, MEAS
Thomas Shahady, Zoology
Randall Jackson, Zoology
Elise Irwin, Zoology
Kimberly Jones, Chemistry (UNC Wilmington)
George Hess, Biomathematics
Ann Darrien, Zoology
Elizabeth Marschall, Zoology

M.S.
Susan Randolph, Science Education
John Grady, Plant Biology
Carolyn Foley, Botany

Chad Coley, Soil Science
Angela Poovey, Crop and Soil Science
Scott Thomas, Biological and Agricultural Engineering
Kristin Toffer, Biology, UNC Greensboro
Beth Buffington, Crop and Soil Science
Edward Walycz, MEAS
Lisa Hartley, Botany
Robert Clark, Zoology
Beth Walker, Zoology
Rose Ragnacci, MEAS
Karen Kracko, Zoology

Postdoctoral Associate Advisor

Meghan Rothenberger, 2007: Present position, Assistant Professor, Lafayette College
Matthew Parrow, 2004-2006: Present position, Assistant Professor, UNC Charlotte
Brant Touchette, 2000-2002: Present position, Associate Professor, Elon University
Cheng Zhang, 1999-2003: Present position, Research Scientist, North Carolina Department of Environment and Natural Resources

Visiting Fulbright Scholar

Allasanne Ouattara, Ivory Coast, 2008-2009: Professor from the University of Abobo-Adjamé

Activities in Other Academic Programs (past five years)

Kenan Fellows Program (for gifted K-12 teachers)

Mentor to Amanda Warren, 2008-2009
Mentor to Susan Randolph, 2008-2009
Mentor to Diane Whittaker, 2006-2007
Secondary mentor to Gayle Powell, 2005-2006
Panelist on selection committee for Kenan Fellows, 2004

Other NC State Service

Member, Radiation Safety Committee (university)
Member, College of Agriculture and Life Sciences Research Committee (college)
Member, Advisory Committee, Plant Biology (departmental)
Member, Green Committee, Plant Biology (departmental)
Chair, Plant Biology Post-Tenure Evaluation Committee (departmental)
Member, Selection Committee for Evolutionary Ecologist Position (departmental)
Member, Larry A. Whitford Botany Scholarship/Fellowship Award Committee (departmental)
Member, Plant Biology Mentoring Committee for Alexander Krings (departmental)
Member, Plant Biology Mentoring Committee for Bill Hoffmann (departmental)
Member, Plant Biology Undergraduate Curriculum Committee (departmental)
Member, Search Committee, Plant Biology - Evolutionary Ecologist (departmental)
Member, Water Quality Committee (university)
Member, Water Resources Curriculum Committee (university)
Member, Ad Hoc Committee on Marine Science (university)
Member, Advisory Committee for the NCSU publication, *Results: Research and Innovation at North Carolina State University* (university, 2011-)

Education Outreach (examples, past five years)

K-12 Students and Teachers

The CAAE's *Floating Classroom Program* aboard our research/education ship, *RV Humphries*: Provided hands-on education in aquatic science (1/2-day cruise on the Neuse Estuary for 345 9th graders and their teachers (2013), 360 9th graders and their teachers (2012), and 480 9th graders and their teachers (2011) from Wayne County schools in economically depressed areas

Guilford County high school teachers' training – presentation to ~30 teachers on designing experiments, 2011

Cardinal Gibbons High School, Cary, NC – presentation to ~80 students on water quality issues nationally and in our State (senior-level courses, *Ecology* and *Environmental Issue*s), 2010

Randleman High School, Randleman, NC – presentation to ~70 students on water quality issues, 2010

General Citizenry (invited presentations, other activities)

Forum on Status of the Neuse Estuary and Industrialized Swine Production (presentation to Coastal River Watch), 2013

Water Quality in High Rock Lake (presentation to the Yadkin Riverkeeper Foundation), 2013

Status of Water Quality in Falls Lake (presentation to the concerned citizens group, Wake Up Wake County), 2010

Other Service

Member, City of Raleigh Stormwater Commission, 2010-present

Society Memberships

American Association for the Advancement of Science, Association for the Sciences of Limnology and Oceanography, Estuarine Research Federation, Society of International Limnologists, North American Lake Management Society, Phi Kappa Phi, Phycological Society of America, Sigma Xi

Exhibit 2

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Impacts to a Coastal River and Estuary from Rupture of a Large Swine Waste Holding Lagoon

JoAnn M. Burkholder,* Michael A. Mallin, Howard B. Glasgow, Jr., L. Michael Larsen, Matthew R. McIver, G. Christopher Shank, Nora Deamer-Melia, David S. Briley, Jeffrey Springer, Brant W. Touchette, and Elle K. Hannon

ABSTRACT

We tracked a swine waste spill (4.13×10^7 L) into a small receiving river and estuary. After 2 d, a 29-km freshwater segment that the wastes had traversed was anoxic, with ca. 4000 dead fish floating and hung in shoreline vegetation. Suspended solids, nutrients, and fecal coliforms were 10- to 100-fold higher at the plume's edge (71.7 mg SS/L, 39.6 mg NH_4^+–N/L, and $>1 \times 10^6$ cfu/100 mL, respectively; cfu, colony forming units, SS; suspended solids) than in unaffected reference sites. Elevated nutrients and an oxygen sag from the plume reached the main estuary after ca. 5 d. Increased phytoplankton production was contributed by noxious algae, *Synechococcus aeruginosa* and *Phaeocystis globosa* (10^8 and 10^6 cells/mL, respectively) after 7 to 14 d. The toxic dinoflagellates, *Pfiesteria piscicida* and a second *Pfiesteria*-like species, increased to potentially lethal densities (10^3 cells/mL) that coincided with a fish kill and ulcerative epizootic. After 14 d, water-column fecal coliforms generally were at 10^2 to 10^3 cfu/100 mL. But where the plume had hovered for the first 5 d, surface sediments mostly yielded $\geq 10^4$ cfu/100 mL slurry, and after 61 d densities in surficial sediments were still at 10^3 to 10^4 cfu/100 mL. Dinoflagellate and euglenoid blooms developed and moved down-estuary, where they were detected after 61 d. This study documented acute impacts to surfacewaters from a concentrated swine operation, and examined some environmental policies affecting the intensive animal operation industry.

Rapid expansion of North Carolina's concentrated animal operations (CAOs) in the late 1980s to early 1990s catapulted the state from 7th to 2nd in swine production in the nation within 5 yr (Barker and Zublena, 1995; Zublena et al., 1995), but proceeded with little comprehension of environmental impacts on adjacent waters. Concentrated animal operations technology, originally designed for application in upland areas with adequate soil depth above the water table (Midwest Plan Service, 1987), was embraced in counties where 60 to 80% of the area put into production was originally low-lying wetlands adjacent to rivers and estuaries (Holman, 1993; Steel, 1991). The operations were exempt from land zoning laws and mandatory inspection programs (Stith and Warrick, 1995). Waste lagoons were not required to have leakage-reducing liners; some were constructed below the water table and <20 m from neighboring homes and wells (North Carolina Department of Environment, Health, and Natural Resources [NCDEHNR]).

Lack of attention toward assessing potential water resource impacts from this industry was compounded by low state financial support for resource conservation. Despite having the second largest estuarine system and fish nursery ground on the U.S. mainland (Epperly and Ross, 1986; Steel, 1991), North Carolina ranks among the 10 lowest states in environmental spending (43rd or 47th; World Resources Inst., 1994, Southern Environmental Law Center, 1994). Accordingly, the North Carolina Division of Water Quality (NCDWQ, formerly the Division of Environmental Management, the agency charged with water resource management within NCDEHNR), lacked the personnel and resources necessary to adequately monitor surface- or groundwater quality (North Carolina Coastal Futures Committee, 1994). More fundamentally, the North Carolina Department of Agriculture (NCDA) legally refused to provide NCDWQ with basic data such as the location and number of existing and planned animal operations (North Carolina General Assembly, 1993; Stith and Warrick, 1995).

After considerable effort the North Carolina Environmental Management Commission, an advisory and rule-making board for NCDWQ formed of governor appointees, passed rules in 1993 for design of animal waste lagoons and effluent treatment. These rules mandated use of clay or other suitable liners in future construction of lagoons associated with operations that involve 250 or more swine. They included a grandfather clause to exempt existing operations from having to alter their lagoon design (NCDEHNR, 1993). When operated properly, lagoons were regarded as a form of primary waste treatment since some nutrient-containing

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Abbreviations: CAO, concentrated animal operation; chl*a*, chlorophyll *a*; cfu, [bacteria] colony forming units; DO, dissolved oxygen; NCDA, North Carolina Department of Agriculture; NCDEHNR, North Carolina Department of Environment, Health, and Natural Resources; NCDMF, North Carolina Division of Marine Fisheries (within NCDEHNR); NCDWQ, North Carolina Division of Water Quality (formerly the North Carolina Division of Environmental Management, within NCDEHNR); NPDES, National Pollution Discharge Elimination System; SRP, soluble reactive phosphate; SS, suspended solids; TP, total phosphorus; WWTP, [municipal] wastewater treatment plant.

solids (with associated oxygen demands in decomposition) settle out, and since some denitrification occurs with biological anaerobic processes, when the wastes are held for a suitable holding period (Dewi et al., 1994; Midwest Plan Service, 1987). Lagoons were to be constructed to contain wastes through a 25-yr, 24-h storm event (highest precipitation over a 24-h period in 25 yr), when used together with a program in which the liquid effluent was sprayed onto fields that had been planted with certain crop plants to absorb and, thereby, partially treat the wastes (Barker and Zublena, 1995; USDA-SCS, 1993). General USDA-SCS equations for water holding capacity of general soil classes were used as a basis to develop regulations stipulating acceptable quantities of effluent to be sprayed (USDA-SCS, 1993). Lagoons and animal housing were required to be maintained at least 8.3 m (25 feet) from perennial waters, and were not to disperse their wastes on saturated ground (NCDEHNR, 1993). Operations built or expanded after 1993 were also required to develop waste management plans (note: additionally, by 1998 limited operation/maintenance standards will be required of operations constructed before 1994).

Extensive research was conducted by land-based bioagricultural engineers to characterize the constituents of swine and poultry wastes (Table 1), and to quantify the nutrients and pathogenic microorganisms remaining in surface or subsurface runoff from the waste treatment practices (Barker and Zublena, 1995; Evans et al., 1984; Huffman and Westerman, 1995; Parsons et al., 1994; Westerman et al., 1985a,b). The emphasis was on reducing pollutants in runoff and disposed effluent through improved best-management practices. Impacts to surface water quality and aquatic communities from remaining pollutants in the runoff had not been rigorously evaluated. Available data from nearly 30 yr of freshwater and estuarine research worldwide nonetheless had established that levels of nutrients and other pollutants reported in runoff associated with accepted practices for municipal and animal waste treatment could promote excessive eutrophication and other water quality degradation in slowly flowing rivers and estuaries (Boynton et al., 1982; Dewi et al., 1994; Henderson-Sellers and Markland, 1987; Jaworski, 1982; Nielson and Cronin, 1981). Moreover, surface water resource deterioration from swine and poultry operations had been documented in other regions, including biological oxygen demand, nutrient loading that supported noxious algal blooms, oxygen deficits, high suspended sediments, and potentially pathogenic microorganisms (e.g., enterrococci, *Salmonella typhi*, *S. paratyphi*, *Clostridium perfringens*, and enteroviruses) (Dewi et al., 1994; Gerba et al., 1985; Melnick and Gerba, 1980; Salmon et al., 1995; Webb and Archer, 1994).

Table 1. Some constituents of swine effluent in holding lagoons from North Carolina.

Parameter (mg/L)	Barker (1997)†	Barker and Zublena (1995)†	Westerman et al. (1990) Range	Westerman et al. (1990) (Mean)†
TS†	1.32 ± 0.18	0.32	0.17–0.52	(0.40 ± 0.13)
COD†	1658 ± 1115	‡	970–2371	(1830 ± 530)
TKN	128 ± 62	563	391–827	(615 ± 170)
NH_3N	81 ± 10	456	336–778	(549 ± 183)
TP	‡	98	69–105	(100 ± 40)
$PO_4{}^{3-}$–P	79 ± 19	‡	56–164	(89 ± 38)

† Parameters include total solids (TS), chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN), ammonia (NH_3–N), total phosphorus (TP), and phosphate ($PO_4{}^{3-}$–P). The low TS values indicate that most solids had settled out before these measurements were taken. Data from Barker and Zublena (1995) pertain to anaerobic lagoon liquid. The Westerman et al. (1990) study included a sample size of five lagoons. Other data available from Barker (1996) were total suspended solids (23.11 ± 4.60 mg/L), 5-d biochemical oxygen demand (BOD_5, 691 ± 240 mg/L), and P_2O_5 (51 ± 28 mg/L).
‡ Data not available.

These impacts from concentrated animal production, described for other areas, were most commonly associated with moderate/high precipitation events that sometimes led to ruptured lagoons, as well as substantial seepage of sprayed effluent, especially when the filtering soils were already saturated (Dewi et al., 1994; Gangbazo et al., 1995; Webb and Archer, 1994; Westerman et al., 1985a). The effects in promoting noxious algal blooms would be expected to be most severe when such precipitation was followed by a period of drier, warm weather in the summer growing season, when such algae tend to thrive (Mallin, 1994). More specific to North Carolina and mid-Atlantic coastal areas, research on groundwaters adjacent to animal operations indicated that poorly constructed lagoons had substantial seepage that could contaminate the subsurface waters with high nutrients (e.g., up to 30 mg NO_3–N/L and >1 mg NH_4^+– N/L) and indicators of harmful microbial pathogens (Bouchard et al., 1992; Evans et al., 1984; Huffman and Westerman 1995, Ritter and Chirnside, 1990). Groundwater contributes a significant proportion of the total flow to many major rivers in the state (McMahon and Lloyd, 1995), suggesting the potential for contamination of adjacent wetlands and surface waters.

In 1995 concentrated animal producers were confronted by an unusually wet early summer; coastal areas received the highest precipitation in 30 yr of available records (Onslow County study area: 43.07 cm in June; North Carolina State Climatological Service records 1995). Various lagoons that had been improperly managed overflowed or ruptured (NCDEQ records). We characterized three large lagoon spills from swine and poultry operations, and associated short-term impacts on receiving rivers and estuaries (see Mallin et al., 1997a). The present work describes the environmental issue of concentrated swine operations within the context of the largest reported swine effluent spill to date in North Carolina, including a summary of public and industry response to the lagoon ruptures.

THE SWINE EFFLUENT SPILL

At approximately 1600 h on 21 June 1995, a lagoon ruptured that had held 4.13 × 10^7 L (4.13 × 10^4 m^3, or 25.8 million gallons) of raw effluent from a concentrated swine operation with ca. 12 000 animals (NCDEHNR records). The lagoon was owned by Oceanview Farm, a managing partner with Coastal Ag-Development, Inc. which is a subsidiary of Purina Mills, located 16 km northwest of the town of Richlands in Onslow County.

The lagoon rupture was preceded by a sustained period of unusually heavy precipitation as described. But the spill occurred because of faulty management by the operators, who had constructed a pipe through one of the lagoon's earthen walls to facilitate effluent transport to fields without adequate crops for spray application (NCDEHNR records). The pipe weakened the wall sufficiently to promote rupture when the lagoon volume approached maximum holding capacity (NCDWQ records). Moreover, the operators had delayed a suitable time course for spray-applying the effluent until they were confronted by the heavy precipitation, which rapidly saturated the adjacent soils so that spraying was no longer an acceptable option for adequate waste treatment. Local citizens informed news reporters after learning of the spill from neighbors late on 22 June; other press had been notified by NCDEHNR personnel. The lagoon had almost completely emptied, filling depressions across fields and lawns of adjacent homes and farms at ca. 27-cm depth for several days.

The effluent flowed overland for ca. 0.5 km and then drained into a small freshwater second-order segment (Strahler, 1964) of the New River (mean stream depth and width ca. 0.25 and 1.5 m, respectively), at a point ca. 1 km downstream from a cattle farm and ca. 40 km upstream from the upper New River Estuary near the city of Jacksonville. Gaging stations were not available in the area that first received the swine effluent. The water width and depth of this segment were ca. 1.2 and 0.25 m, respectively (volume estimated at 5 m^3 over a 20-m distance, or ca. 10^4-fold less than the spill volume), ca. 2 d after the lagoon rupture. The watermark on vegetation before the effluent perturbation was ca. 40 cm lower than the watermark left by the effluent plume.

THE STUDY AREA

The New River originates in the vicinity of the study area, and drains mostly agricultural lands and forest for ca. a 35-km length down to the estuary. With exception of the city of Jacksonville (population ca. 30 000) and small villages, much of the watershed surrounding the New River Estuary is maintained as forested training grounds by the Camp Lejeune Marine Base (population 74 000; Onslow County Planning Board, 1992). The ca. 6.15×10^3 km^2 of watershed area are predominantly forest (55%) and wetlands (24%, including the New River ecosystem), with agricultural lands only representing 9% of the land (Onslow County Planning Board, 1992). Nonetheless, animal wastes contribute more than 2.7 to 4.1×10^5 Mg of manure/yr to the New River basin, including 3100 Mg of N and 2100 Mg of P (Barker and Zublena, 1995). More than 40% of the N and more than 100% of the P requirements of agronomic and forage crops in the watershed (Onslow County) were supplied by animal manures as of 1995, figures that indicate that the drainage basin soils already are replete in P needed for plant growth on spray fields and other locations (Zublena et al., 1995).

For more than a decade, both freshwater and estuarine segments of the New River have been classified as nutrient-sensitive waters (NSWs), in recognition of the potential for increased noxious algal blooms, oxygen deficits, fish kills, and other signs of cultural eutrophication with additional nutrient loading (NCDEHNR, 1990). Many of its 42 wastewater treatment plants (WWTPs) occur near Jacksonville and down-estuary as small unmonitored package plants ($<1.9 \times 10^6$ L/d, or 0.5 mg/d; NCDWQ records). Six of seven major wastewater treatment systems in the basin (with $>1.9 \times 10^6$ L discharge/d) are on the marine base down-estuary from Jacksonville, and all seven (including the city of Jacksonville's municipal wastewater treatment plant) have chronically malfunctioned for at least the past 5 yr (NCDWQ records 1991–1995).

These domestic and agricultural inputs have led to description of the New River Estuary (from Wilson Bay, Jacksonville, downstream; surface area, ca. 85 km^2; mean depth 2.1 m in the sampling area) as a highly sewage-enriched coastal lagoon (Mallin et al., 1997b; NCDEHNR, 1990). The effects of excessive nutrient enrichment likely have been exacerbated because of slow flushing rates in the upper estuary above its constriction at the highway 172 bridge, Sneads Ferry (NCDEHNR, 1990; Station SNF, Fig. 1). Most of the major WWTPs ($\geq 1.9 \times 10^6$ L, or ≥ 0.5 mg/d) discharging to the estuary, including one in Jacksonville and seven in the Camp Lejeune Marine Base, have been operating under special orders of consent from DEQ for several years in recognition of National Pollution Discharge Elimination System (NPDES) permit violations (NCDWQ records 1991–1995). Historically, the estuary has supported commercial blue crab and shrimp fisheries in some areas (North Carolina Division of Marine Fisheries [NCDMF], 1993).

The New River has only one U.S. Geological Survey (USGS) discharge station located on Gum Branch Creek, ca. 25 km downstream from the spill area (Fig. 1, station GMB). Flow data for that station reflected previous weeks of high precipitation. The volume at station GMB was ca. 260 m^3 over a 20-m distance (calculated using maximum recorded depth 2.5 m and width 6.5 m), in comparison to the previously mentioned volume of 5 m^3 over a 20-m distance at station INP in the spill entry point. Current velocity at station GMB had been measured at 1.46×10^5 m^3/h (1.43×10^3 ft^3/sec) on 7 June 1995, declining to 1.91×10^4 m^3/h by the spill date on 21 June, and to 1.37×10^4 m^3/h by the first sampling date. The current velocity in the third week of June was comparable to flow data recorded for January 1996, which was characterized by frequent precipitation events. Precipitation at 5 d after the spill increased the current velocity at this station to 5.33×10^4 m^3/h, which promoted dilution and movement of the plume downstream into the estuary. July to August 1996 were much drier, with mean daily current velocity of 2.24 to 7.65×10^3 m^3/h (USGS records, Raleigh, NC).

SAMPLING AND ANALYTICAL METHODS

We first sampled the spill area from 1300 to 2000 h on 23 June, ca. 40 h (nearly 2 d) after the lagoon rupture and ca.

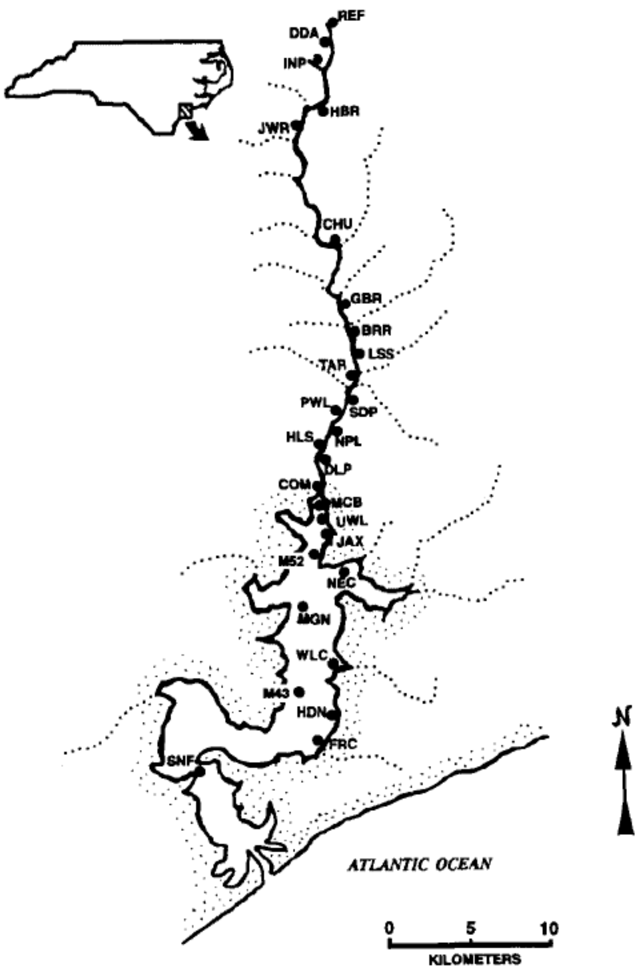

Fig. 1. The study area in the New River and the New River Estuary, North Carolina, showing the location of the spill, the freshwater sampling sites (REF–COM), freshwater to oligohaline sites (MCB to upper Wilson Bay, UWL), an oligohaline site (JAX, near the outfall of the city of Jacksonville municipal wastewater treatment plant), an oligohaline to mesohaline site (M52), mesohaline sites (Northeast Creek to French's Creek, NEC–FRC), and a polyhaline site (Sneads Ferry, SNF).

24 h after the last of the major effluent volume had drained into the affected New River segment. At this time the plume was visible in the river within a ca. 31-km length downstream of the effluent entry point. Water on the first sampling date was collected at one reference station upstream from the affected area (site REF), five sites within the effluent plume (sites INP–GBR, and NPL), and one site (MCB) downstream from the plume's leading edge (note that station DDA, the drainage ditch from crop fields sprayed with swine effluent at another CAO upstream from Oceanview Farm near the REF site, was sampled subsequently; Table 2, Fig. 1). On other dates (5, 14, 33, and 61 d after the spill), we sampled stations in freshwater river segments and the upper estuary (stations BRR–PWL and HLS–COM, respectively; Table 2, Fig. 1), depending on our ability to detect the plume's location. On two dates (at 14 and 61 d after the spill), we additionally sampled surficial sediments in freshwater and upper estuarine segments traversed by the plume. The water column was also sampled in the New River Estuary from above the Jacksonville municipal wastewater treatment plant in upper Wilson Bay to Sneads Ferry, an area that we had characterized for 10 mo of what had been intended as a 12-mo study of baseline environmental conditions (10 stations from JAX to SNF; Fig. 1). Following several major precipitation events along with tidal mixing, the plume was dispersed within the estuary and could not be detected on the basis of the measured parameters that were within financial means for consideration, given the emergency status of sampling the spill event. Use of more advanced but expensive techniques (e.g., molecular probes for certain microbial pathogens, stable isotopes for C and N, etc.) was not possible, but likely would have improved plume detection and documentation of adverse impacts.

In the affected freshwater region of the river, a model 57 YSI meter with probe 5739 was used to measure temperature and dissolved oxygen (DO) near the surface of the water column (0.25 m; first and second sampling dates) or depth profiles were obtained with a Hydrolab (H_2O multiprobe datalogger and transmitter with SVR3-DL stirrer; the remaining dates). The DO data for the first sampling date were supplied from the sampling area by NCDWQ because of a malfunctioning probe on our DO meter. Salinity was measured using a Reichert refractometer (dates 1 and 2) or a Hydrolab, and specific conductance also was determined with a Hydrolab. Secchi depth was recorded as an index of water clarity (Wetzel and Likens, 1991), and pH was measured using a hydrolab along with supplemental data from NCDWQ.

The water column was also sampled at depth 0.25 m for nutrients (total phosphorus, TP; nitrate, NO_3–N; and ammonia as NH_4^+–N), suspended solids (SS; nutrients and SS in duplicate or, later in the study, with 10% replication to ensure agreement to within ±5%), and fecal coliform bacteria (with 10–50% replication). Nutrient concentrations were measured with a Traccs 800 autoanalyzer using USEPA-approved methods (USEPA, 1993). Ammonia analysis followed the USEPA-approved and American Public Health Administration (APHA)-approved Solórzano method, except that phenol reagent was added in the field to act as a preservative that minimized contamination (Burkholder et al., 1992a). Total P was acid-digested in a Technicon BD-40 block digester and assayed colorimetrically. Suspended solids were determined according to APHA et al. (1992).

Fecal coliform densities were measured by state-certified commercial laboratories (Environmental Chemists, Wilmington, NC; and Land & Lab, New Bern, NC; most-probable-number technique), and by the Environmental Virology Laboratory, UNC-Chapel Hill (membrane filter technique). From five sites in the area from BRR to MCB, water samples that were collected 5 d after the spill were also analyzed on one date by the Environmental Virology Laboratory for enterococci, *Clostridium perfringens*, and fecal coliphages (note: high fees prevented additional analyses). Sediment samples for fecal coliforms (depth 0–2 cm) were collected using a commercial-quality vacuum head (American Products Module 2P915) that was specially modified and fitted to enable suction of ≤2.0 cm depth of surficial sediments from a 0.25 m^2 area with a 1 HP L2VDC vacuum pump. The pump was connected by a 1.9-cm diameter lockline acid-resistant nontoxic hose. This technique was rigorously tested in preliminary trials, and it successfully removed only the upper 2 cm of sediment along with overlying water (sediment slurry).

Sampling in the estuary was initiated on 26 June, ca. 5 d after the swine effluent spill. Temperature, DO, salinity, specific conductance, and pH in the estuary were measured with a Solomat WP803 water quality meter at 0.5-m depth intervals. Water samples were collected at depth 0.25 m for nutrients, SS, chlorophyll *a* (chl*a*), and fecal coliforms (chl*a* in triplicate; NO_3^-–N, soluble reactive phosphate [SRP], and NH_4^+–N in duplicate; other variables with 20% replication, except for 10% replication of fecal coliform samples). Nutrients, SS, and fecal coliforms were analyzed using the same procedures as indicated above, with nutrients analyzed using a Bran-Lubbe TRACCS 800 autoanalyzer. The chl*a* was extracted in 90% basic acetone (Wetzel and Likens, 1991) and analyzed in tripli-

Table 2. Sampling sites and locations on the New River and its estuary.

Designation	Location/description
REF	Reference site 1, depth (z) ca. 10 cm; about 1 km upstream from the entry point of the swine effluent spill; at confluence with a 1st-order stream on Alphin Rd. (State Road 1234), along woodline with adjacent swine effluent spray fields, cow pastures, and corn (*Zea mays* L.)–soy [*Glycine max* (L.) Merr.] crops.
DDA	Drainage ditch from fields with spray application of swine effluent from a swine operation, about 0.4 km east of reference site REF, which was upstream from Oceanview spill.
INP	New River, freshwater area where the spill entered via overland transport and ditches, ca. 0.5 km from the swine operation on Taylor Rd. (State Road 1235); stream width = 1.2 m; maximum depth (Z_{MAX}) = 0.25 m.
HBR	Freshwater region at Haw Branch Rd. (State Road 1230, between State Roads 1234 and 258); distance downstream from the Oceanview swine operation and spill entry area (d, as river distance) = 3.2 km; Z_{MAX} = 1.75 m.
JWR	Freshwater, at intersection of Highway 24 and Jesse Williams Rd. (State Road 1233); d = 6.4 km, Z_{MAX} = 0.25 m.
CHU	Freshwater, at Highway 24/State Road 258, by a church and near agricultural crop fields; d = 14.5 km, Z_{MAX} = 1.0 m.
GBR	Freshwater, at Gum Branch Rd. (State Road 1434); d = 19.3 km, Z_{MAX} = 2.5 m.
BRR	Freshwater, below Rhodestown Rd; d = 22.5 km, Z_{MAX} = 2.3 m.
LSS	Freshwater in a long straight river segment; d = 24.2 km, Z_{MAX} = 2.2 m.
TAR	Freshwater, d = 25.8 km, Z_{MAX} = 2.2 m.
SDP	Freshwater, by a sewer discharge pipe; d = 27.4 km, Z_{MAX} = 2.5 m.
PWL	Freshwater, in an open area by power lines; d = 29.0 km, Z_{MAX} = 2.5 m.
NPL	Freshwater, by power lines; d = 30.6 km, Z_{MAX} = 2.0 m; location of effluent plume's leading edge on first sampling date (Day 2).
HLS	Freshwater, at Haw Landing Subdivision; d = 33.8 km, Z_{MAX} = 2.5 m.
DLP	Freshwater, in an area crossed by double power lines; d = 35.4 km, Z_{MAX} = 5.0 m.
COM	Freshwater, at a curve in the river, ca. 1.6 km upstream from the U.S. Highway 17 bridge channel marker; d = 37.0 km, Z_{MAX} = 4.0 m.
MCB	Freshwater to oligohaline estuary, midchannel at the bridge on U.S. Highway 17 in Jacksonville; served as a downstream reference site on the first sampling date (Day 2); d = 40.2 km, Z_{MAX} = 4.5 m.
UWL	Freshwater to oligohaline estuary, in upper Wilson Bay near a marina; d = 43.2 km, Z_{MAX} = 1.7 m.
JAX	Oligohaline estuary, near the outfall of the city of Jacksonville municipal wastewater treatment plant in Wilson Bay; d = 46.4 km, Z_{MAX} = 2.0 m; 32.0 km from confluence with the Atlantic Ocean.
M52	Oligohaline–mesohaline estuary, channel marker 52 between lower Wilson Bay and the main estuary; d = 50.5 km, Z_{MAX} = 3.0 m; 29.0 km from confluence with the Atlantic Ocean.
NEC	Mesohaline estuary, near confluence with Northeast Creek; d = 51.5 km, Z_{MAX} = 2.5 m; 29.0 km from confluence with the Atlantic Ocean.
MGN	Mesohaline estuary, in Morgan Bay near channel marker; d = 51.8 km, Z_{MAX} = 3.0 m; 26.0 km from confluence with the Atlantic Ocean.
M43	Mesohaline estuary, channel marker 43; d = 55.8 km, Z_{MAX} = 3.1 m; 22.0 km from confluence with the Atlantic Ocean.
WLC	Mesohaline estuary, near confluence with Wallace Creek; d = 61.4 km, Z_{MAX} = 1.0 m; 24.5 km from confluence with the Atlantic Ocean.
HDN	Mesohaline estuary, near a major wastewater treatment plant of the U.S. Marine Corps Base at Camp Lejeune; d = 58.2 km, Z_{MAX} = 1.0 m; 20.0 km from confluence with the Atlantic Ocean.
FRC	Mesohaline estuary, near confluence with French's Creek; d = 59.8 km, Z_{MAX} = 1.2 m; 18.7 km from confluence with the Atlantic Ocean.
SNF	Polyhaline estuary, near Highway 172 bridge at Sneads Ferry; d = 71.7 km, Z_{MAX} = 6.5 mL; 8.2 km from confluence with the Atlantic Ocean.

cate with a Turner 10-AD fluorometer, using acidification to correct for pheopigments (Parsons et al., 1984). Subsamples were also examined for abundance of noxious microalgae and toxic mixotrophic/heterotrophic dinoflagellates, following techniques of Burkholder et al. (1995).

RESULTS

Freshwater Segments on Day 2

On Day 2 (23 June 1995, ca. 40 h after the breach occurred) we sampled reference site REF above the point where the plume had entered the river, affected areas down to the leading edge of the effluent at site NPL, and reference site MCB that was still downstream from the plume. All of these sites were in freshwater segments (salinity <1 psu throughout the water column—Wetzel, 1983; Table 2, Fig. 1). Although the spill had occurred >40 h before it was first sampled, the data for DO, nutrients, SS, water clarity, and fecal coliforms clearly defined the plume's location and areal extent. The affected area was also easily discerned by odor. The entire freshwater river area traversed by the plume (length ca. 31 km at NPL) was anoxic from surface to bottom, except for a reading of 1 mg DO/L at station TAR (note that the state standard for these freshwaters is ≥5.0 mg /L daily average, with a minimum instantaneous value of ≥5 mg/L, unless caused by natural conditions; NCDEHNR, 1996). Numerous dead fish (mostly sunfish, *Lepomis* sp.; sheepshead, *Archosargus probatocephalus* Walbaum; and redfin pickerel *Esox americanus* Gmelin; with occasional striped mullet, *Mugil cephalus* L.; southern flounder, *Paralichthys lethostigma* Jordan & Gilbert; and spot, *Leiostomus xanthuris* Lacepede), were found throughout the affected area, with carcasses both floating and hung in vegetation along the stream banks (authors' observations and data, NCDMF records). Total dead fish were estimated at >4000 (assessment techniques of the American Fisheries Society, 1982; NCDMF records). We also found freshly dead and moribund sessile invertebrates on the river sediments (e.g., several clams, *Corbicula*, and numerous insect larvae).

Suspended solids on the first sampling date were 7.6 ± 0.5 mg/L and 4.4 ± 0.2 mg/L, respectively, at the up-

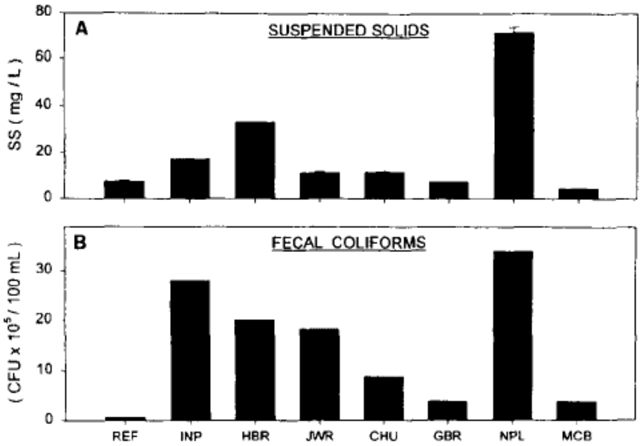

Fig. 2. (*A*) Suspended solids concentrations and (*B*) water-column fecal coliform densities on the first sampling date, 2 d after the swine effluent spill from Oceanview Farm. Sites REF and MCB were used as upstream and downstream reference sites, beyond the influence of the spill on that date; sites INP to NPL were in the affected area (means ±1 SE). Note that SS were significantly higher at affected sites INP–NPL than at REF and MCB ($P < 0.05$ except $P < 0.01$ for site NPL at the plume's leading edge); and fecal coliforms were significantly higher at sites INP–NPL than at the reference sites ($P < 0.01$), except for site GBR, which was similar to MCB.

stream and downstream reference sites (REF and MCB; Fig. 2A). Within the area traversed by the plume, SS levels were highly variable and ranged from 7.3 ± 0.1 mg/L (site GBR; mean ±1 SE) to 33.2 ± 0.1 mg/L at site HBR. Site INP, where the plume had first entered, measured 17.5 ± 0.1 mg SS /L. Both suspended solids from swine wastes and eroded sediments added in overland runoff were observed to contribute to the SS loading. The plume's leading edge (site NPL) was associated with the highest SS level at 71.7 ± 2.4 mg/L. As expected, the data for water clarity also indicated turbid conditions at sites with high SS. Transparency generally was <20% of the stream depth at stations INP–GBR and at the downstream reference site for that date (station MCB). At site NPL, however, Secchi depth transparency decreased to 5% of the stream depth (0.1-m Secchi, vs. stream depth 2.0 m).

Fecal coliform densities did not conform to the state standard of waters safe for human contact (<200 cfu/100 mL; NCDEHNR, 1996) at any of the sites sampled, including the reference areas with densities at 5.95 × 10^4 to 3.800 × 10^5 cfu/100 mL (sites REF and MCB, respectively; Fig. 2B). Nonetheless, both reference sites were lower in water-column fecal coliforms than the area affected by the swine effluent plume. Fecal coliforms were >1 × 10^6 cfu/100 mL in four of the six sites sampled within the plume (mean 1.882 ± 0.462 × 10^6 cfu/100 mL); the highest density, 3.400 × 10^6 cfu/100 mL, was measured at the plume's leading edge (site NPL). The relatively high fecal coliform densities in the reference sites on Day 2, while 10- to 100-fold lower than densities in the area affected by the plume, likely reflected inputs from the upstream swine farm (site REF), agricultural crop fields (site CHU), or the urban setting of Jacksonville (MCB; Howell et al., 1995; Marion and Gannon, 1991; Webb and Archer, 1994).

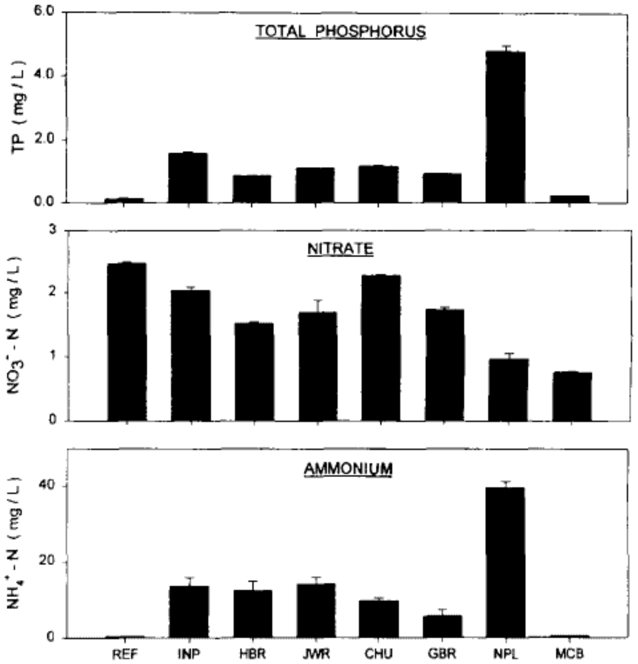

Fig. 3. Nutrient concentrations on the first sampling date, 2 d after the swine effluent spill (sites REF and MCB were reference sites, as compared with sites INP–NPL in the affected area; means ± 1 SE). Note that TP and NH_4^+–N both were significantly higher in affected sites INP–NPL than at REF and MCB ($P < 0.05$ except $P < 0.01$ for site NPL at the plume's leading edge).

High nutrient concentrations were measured on Day 2 within the affected area relative to conditions in the upstream and downstream reference sites, with nutrient maxima at the plume's leading edge. Most of the total N within the plume area consisted of NH_4^+ (Fig. 3). Ammonium was 0.12 ± 0.01 mg NH_4^+–N/L at reference stations REF and MCB. By comparison, concentrations averaged 11.07 ± 1.52 mg NH_4^+–N/L (range 5.81–14.03 mg/L) at sites INP–GBR. The maximum level, 39.65 ± 2.44 mg NH_4^+–N/L at site NPL, is known to be lethal to most adult fish species as NH_4^+–N in acute toxicity assays (McKee and Wolf, 1963; McNeely et al., 1980). A similar trend in concentration among stations was observed for TP; at the two reference sites TP was measured at 0.16 ± 0.04 mg/L, vs. 1.14 ± 0.12 mg/L in sites INP–GBR, and 4.79 mg/L at the plume's leading edge (site NPL; Fig. 3). Relatively high NO_3^- at the upstream reference site (2.47 ± 0.02 mg NO_3^-–N/L) may have been contributed from oxidized cattle or swine wastes or other basin sources in upstream locations (e.g., Webb and Archer, 1994). The plume's leading edge was lower in NO_3^- (0.97 ± 0.09 mg NO_3^-–N/L), expected since NH_4^+ forms most of the inorganic N in the reducing environment of raw swine wastes (Barker and Zublena, 1995; Dewi et al., 1994).

Freshwater Segments on Day 5

At 5 d after the swine effluent spill (26 June, second sampling date), ensuing precipitation and the flushing effect of associated higher flow had moved the plume downstream so that the leading edge had reached estuarine site JAX below the Jacksonville wastewater treat-

Table 3. Environmental conditions in the New River and its estuary on 26 June 1995, ca. 5 d after the swine effluent spill. Stations are listed proceeding from upstream down toward the estuary's confluence with the Atlantic Ocean.

Station	Depth†	Temp.	DO	Salinity	Sp. Cond.†	pH	Secchi	Turbidity
		°C	mg/L	psu	μS/cm²		m	jtu
DLP	S	24.1	4.7	0.1	0.2	7.5	0.2	82.8
	B	23.2	2.6	0.1	0.2	7.0		19.3
COM	S	23.7	4.5	0.1	0.2	7.4	0.4	25.3
	B	22.6	4.1	0.1	0.2	7.0		29.3
MCB	S	27.9	4.9	0.1	0.4	7.6	0.4	8.2
	B	23.5	0.7	3.4	7.1	7.1		17.8
UWL	S	30.0	5.4	0.2	0.6	7.4	0.4	14.4
	B	24.8	0.4	0.7	1.2	7.0		16.8
JAX	S	29.3	6.3	1.9	3.7	7.4	0.4	12.6
	B	27.0	0.7	5.6	11.2	7.0		6.5
NEC	S	33.3	10.1	8.6	14.8	8.5	0.5 (B)	18.0
	B	33.7	9.6	8.6	14.8	8.5		22.8
MGN	S	32.6	9.9	7.5	13.0	8.5	0.5	10.9
	B	32.8	9.7	7.5	13.0	8.5		11.2
WLC	S	28.7	8.4	9.5	16.4	8.3	0.7	9.3
	B	28.0	6.4	10.7	17.6	8.2		10.6
HDN	S	32.1	9.6	12.7	20.3	8.5	0.6 (B)	11.9
	B	32.1	9.8	12.1	20.3	8.5		13.1
FRC	S	31.8	9.0	13.2	22.1	8.4	0.7 (B)	11.8
	B	31.8	8.7	13.3	22.1	8.4		12.9
SNF	S	29.6	6.0	18.4	30.1	8.1	1.1	4.9
	B	28.0	5.4	20.9	33.3	8.0		12.9

† Depth is indicated as surface (S, upper 0.5 m) and bottom (B, lower 0.5 m) of the water column; μS = μSiemens, equivalent to μmohs.

ment plant (JWWTP; ca. 46 km downstream from the point where the effluent first had entered the river; Table 2, Fig. 1). Sites DLP–MCB within a freshwater area (salinity <1 psu) were sampled as well as two sites in the upper New River Estuary (WLB down to JAX, respectively; Table 2, Fig. 1). The high precipitation in the New River watershed was apparent from the low salinities that were measured in the upper estuary (UWL to JAX—0.2–1.9 psu surface, 0.7–5.6 psu bottom [Table 3]; maximum depth 2.0 m). By comparison, during drier summers surface salinities in this area generally average 8 psu (Mallin et al., 1997b; NCDEHNR, 1990). Distinctive swine effluent odors were detected at all of these stations including the JWWTP site (JAX).

Maximum SS levels within the plume's influence were observed at station DLP (47.8 mg SS/L); at four other sites examined after 5 d, SS were substantially lower and averaged 11.2 ± 1.0 mg/L. Dissolved oxygen at sites DLP–COM still violated the state standard throughout most of the water column, measuring 2.6 to 4.1 mg/L in the bottom waters with surface maxima at 4.5 to 4.7 mg/L (Table 3). At stations MCB, UWL, and JAX, a salt wedge likely contributed to the nearly anoxic DO values recorded from the lower water column (0.4–0.7 mg/L at depth ≥1.5 m). Suspended sediments, nutrients, and fecal coliforms aided in tracking the plume down to sites DLP–COM. With transport downriver over the 5-d period since the spill, some NH_4^+ from the swine effluent spill likely was biologically and chemically (via diffusion of oxygen from the overlying air) transformed to NO_3^- (Stumm and Morgan, 1996). Hypoxia, rather than anoxia (Table 3), and higher NO_3^- were measured in surface waters of down-stream affected sites DPL–COM (1.630 ± 0.002 mg NO_3^--N/L). Ammonium was highest a short distance farther downstream in Wilson Bay (UWL).

At the remaining three downstream sites sampled after 5 d, NO_3^--N averaged 0.79 ± 0.14 mg/L, and was lowest at 0.53 mg/L at site JAX in the JWWTP area. This concentration was comparable to levels measured near the JWWTP during high-precipitation periods in the previous January to March (0.47–0.70 mg NO_3^--N/L), but it was 10-fold higher than during drier periods in April to May (ca. 0.03–0.06 mg NO_3^--N/L; authors' data; Table 4). Ammonium concentrations in the JAX area were significantly higher in late June (5.48 ± 0.105 mg NH_4^+-N/L, mean ±1 SE) than at any other time during prior data collection at that location, including winter–spring high-precipitation periods (mean ±1 SE from January through May 1995, 0.14 ± 0.11 mg/L; range 0.11–0.18 mg/L; authors' data). Phosphorus concentrations followed a similar trend as NH_4^+, with highest TP measured over a 10-mo period during late June (0.703 ± 0.008 mg/L; range in the previous 10 mo, 0.052 to 0.170 mg/L; authors' data). The SRP, which averaged 0.047 ± 0.006 mg/L at JAX for 10 mo before the spill (authors' unpublished data, monthly intervals), ranged from 0.106 mg/L (Day 14) to 0.360 mg/L (Day 5) following the swine effluent spill (Table 4). Thus, the nutrient signal from the swine effluent spill was clear despite the

Table 4. Comparison of mean inorganic nutrient concentrations (mg/L) in site JAX before and after the swine effluent spill 32 km upstream. Note that duplicate nutrient concentrations (SRP, NO_3–N) or triplicate samples (NH_4^+–N) were similar to within ±5%. Asterisks (*) indicate that the data are significantly different (Student's t test, $p < 0.05$).†

Period	SRP	NH_4^+–N	NO_3^-–N
10-mo mean before spill	0.047	0.078	0.247
5 d after spill	0.360*	5.481*	0.533*

† In freshwaters, 0.015 mg TP/L and 0.300 mg inorganic N (NH_4–N + NO_3^-–N)/L are considered to indicate eutrophic conditions (Sawyer, 1947; Vollenweider, 1968).

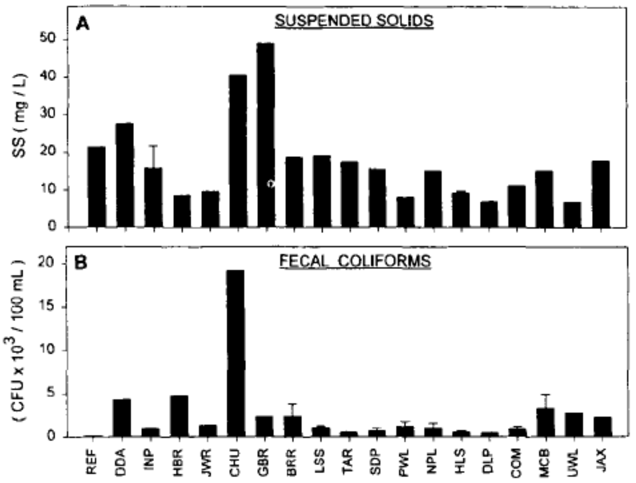

Fig. 4. (*A*) Suspended solids concentrations and (*B*) water-column fecal coliform densities 14 d after the swine effluent spill, showing sites that were in the known affected area by that time. Data are given as in Fig. 2.

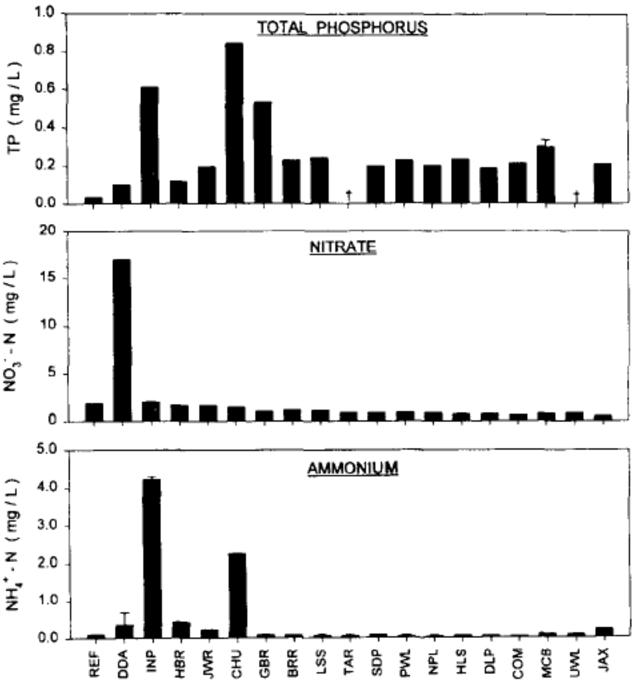

Fig. 5. Nutrient concentrations 14 d after the swine effluent spill, showing sites that were in the known affected area. Data are given as in Fig. 3 (note: † = data not available).

presence of the JWWTP. Nonetheless, nutrient levels measured near the JWWTP after the swine effluent spill likely were also influenced to some extent, as during previous high-precipitation periods, by treatment plant malfunctions that involved bypassing raw or poorly treated sewage into the estuary during moderate to heavy rainstorms (NCDWQ records).

Fecal coliforms in the water column of the plume area 5 d after the spill were $\geq 7.0 \times 10^2$ cfu/100 mL, with a maximum density of 2.7×10^3 cfu/100 mL at station DLP. Station DLP also was associated with highest abundances of *Escherichia coli* (9.5×10^2 cfu/100 mL), enterococci (1.96×10^3 cfu/100 mL), and *Clostridium perfringens* (4.6×10^2 cfu/100 mL). Fecal coliphages were measured at 60 pfu/100 mL at station DLP vs. 280 cfu/100 mL near the JWWTP (site JAX). The second highest density of enterococci, 2.0×10^2/100 mL, was found at site COM. Undesirable levels of *C. perfringens* (Bisson and Cabelli, 1980; Fujioka and Shizumura, 1985) were found among four of the five sites sampled, with 10-fold lower densities of *C. perfringens* in upper Wilson Bay (UWL).

Freshwater Segments on Day 14

At 14 d after the spill (5 July, Sampling Date 3), we characterized water quality of the river and upper estuary that previously was known to have been traversed by the swine effluent (from reference site REF above the discharge down to the mesohaline estuary; Fig. 1). A drainage ditch (DDA) from effluent-sprayed lands at another swine operation, Neuhoff Farms adjacent to REF, was also sampled to provide information about upstream influences on water quality in the area affected by the swine effluent plume. Suspended solids concentrations were highly variable and ranged from 6.9 to 49.0 mg/L without apparent pattern (Fig. 4A). Site DDA was characterized by high nutrient concentrations (17.03 mg NO_3^-–N/L, 0.10 mg TP/L, 0.36 mg NH_4^+–N/L) and moderately high fecal coliform densities (4.3×10^3 cfu/100 mL), indicating appreciable influence of the swine operation on water quality of the receiving stream (Howell et al., 1995; Sherer et al., 1988; Fig. 4, 5).

Water-column fecal coliforms were highly variable after 14 d and ranged from $<2 \times 10^0$ to $>1.9 \times 10^4$ cfu/100 mL (Fig. 4B). Highest fecal coliform densities were measured at site CHU, likely as another nonpoint source from runoff draining tilled soils on crop fields. Densities at 7 of the 17 river sites down to JAX exceeded the state standard (≤ 200 cfu/ 100 mL; NCDEHNR, 1996). However, fecal coliform abundances had declined by ca. 100- to 1000-fold relative to their numbers on Day 2, with losses attributed to washout, death, or settling out to form active populations on the bottom sediments (Davies et al., 1995; Howell et al., 1995). Dissolved oxygen levels measured at sites BRR–DLP generally were >4.0 mg/L throughout the water column except at sites COM–JAX where bottom-water DO ranged from 3.05 to 4.13 mg/L. Upstream stations that previously had been impacted by the swine effluent plume generally measured >5.0 mg DO/L, with progressively lower surface DO levels with distance downstream likely reflecting a shorter period afforded for recovery after the plume passed through. The pH was comparable among freshwater stations regardless of location (Table 5).

Nitrate at 14 d after the spill was ≥ 0.60 mg NO_3^-–N/L at all stations from reference station REF to Wilson Bay (UWL; Fig. 5). But site DDA, the drainage ditch from another swine operation near the REF site, measured higher than 15 mg NO_3^-–N/L. The TP was low at REF (0.04 mg/L), but most stations downstream to JAX maintained concentrations of >0.20 mg TP/L. Ammonium at REF (ca. 0.10 ± 0.01 mg NH_4^+–N/L) was compa-

Table 5. Environmental conditions in the New River Estuary on 5 July 1995, ca. 14 d after the swine effluent spill. Stations are listed proceeding from upstream down toward the estuary's confluence with the Atlantic Ocean.†

Station	Depth	Temp.	DO	Salinity	Sp. Cond.	pH	Secchi	Turbidity
	m	°C	mg/L	psu	μS/cm²		m	jtu
MCB	0.2	28.6	4.0	0.1	0.2	6.8	0.4	24.5
	1.0	24.2	2.4	0.1	0.3	6.7		36.0
	2.0	24.0	3.0	0.4	1.2	6.7		36.0
	3.0	24.1	0.0	1.1	2.2	6.7		34.0
UWL	0.2	27.5	4.5	0.1	0.3	6.8	0.5	21.5
	1.0	25.0	3.2	0.2	0.6	6.7		21.5
	2.0	24.3	3.2	0.2	0.7	6.7		23.0
	3.0	26.2	0.0	3.9	7.9	6.8		18.0
	4.0	26.8	0.0	6.2	11.0	6.9		26.2
JAX	0.2	28.8	10.0	1.4	2.7	7.0	0.5	17.3
	1.0	26.6	7.7	2.7	4.9	6.9		15.3
	2.0	28.7	5.8	6.9	12.2	7.2		14.0
M52	0.2	30.9	9.0	3.7	6.8	8.0	0.4	15.0
	1.0	29.0	7.3	6.4	11.2	7.7		8.0
	2.0	27.9	0.8	13.2	22.4	7.1		5.3
	2.8	27.4	0.5	12.5	21.0	7.1		8.0
NEC	0.2	31.0	7.8	6.2	10.9	8.0	0.5	17.2
	1.0	29.5	5.4	8.6	14.8	7.9		8.2
	2.0	27.9	0.7	13.6	22.7	7.0		5.7
	2.5	‡	0.5	‡	‡	‡		‡
MGN§	0.2	30.5	9.2	8.5	12.8	8.5	0.7	10.0
	1.0	29.5	10.2	8.4	14.5	8.4		7.2
	2.0	28.5	8.4	7.2	21.7	7.2		16.5
	2.5	‡	4.0	‡	‡	‡		‡
	3.0	27.5	0.3	7.0	24.7	7.0		18.0
M43	0.2	31.0	10.5	9.2	15.8	8.5	1.0	6.9
	1.0	29.3	8.7	9.6	16.4	8.4		6.2
	2.0	28.7	0.7	13.9	23.1	7.3		6.7
	3.0	28.6	0.0	16.3	26.7	7.3		9.0

† Last water-column measurements taken at ca. 0.2 m from the bottom sediments.
‡ Data not available.
§ Algal bloom discernible.

rable to concentrations measured at many sites in the affected area. Highest NH_4^+–N levels were observed at sites INP (by Oceanview Farm) and CHU (4.23 ± 0.06 and 2.27 ± 0.02 mg NH_4^+–N/L, respectively, at sites INP and CHU). Site JAX was ca. 10-fold lower than these upstream sites (0.24 mg NH_4^+–N/L). Suspended algal (phytoplankton) chl*a* 14 d after the spill was low at all sites upstream from UWL (<15 μg/L).

Sediment fecal coliform densities were variable as expected, given known extreme heterogeneity in microbial colonization of benthic habitats (Davies et al., 1995; Sherer et al., 1988; Stevenson, 1996). These data, nonetheless, provided strong evidence in support of the premise that microbial pathogens had settled out during the 5-d period when the plume had slowly moved downstream to the area above Jacksonville, and had continued to thrive in the surficial sediments (e.g., Howell et al., 1995). In freshwater segments that had been impacted by the swine effluent plume, viable fecal coliform densities in the upper 2 cm of benthic sediments were significantly higher than densities in the overlying water column (Fig. 6). In 8 of 10 sites sampled within the affected area, viable fecal coliforms were 1.1 to 9.5 × 10^4 cfu/100 mL sediment slurry (or 7.14 × 10^4 to 6.234 × 10^5 cfu/100 g wet sediment); in the remaining two locations, densities were >1 × 10^3 cfu/100 mL sediment slurry (or 6.6 × 10^3 cfu/100 g wet sediment). Highest sediment fecal coliform levels were >1.6 × 10^5 cfu/100 mL sediment slurry (mean 6.25 ± 3.25 × 10^4 cfu/100 mL sediment slurry, or 4.10 ± 2.11 × 10^5 cfu/100 g wet sediment) in a sample from site MCB; *Escherichia coli* averaged 9.50 ± 6.50 × 10^4 cfu/100 mL sediment slurry (or 6.23 ± 4.27 × 10^5 cfu/100 g wet sediment) in site MCB, where the data indicated contamination.

Freshwater Segments on Day 61

The water column in freshwater segments from upstream reference site REF to Wilson's Bay (UWL) was last sampled for short-term impacts 61 d after the spill (21 August). At this time, both the drainage ditch (site DDA) from the CAO adjacent to reference site REF and the New River adjacent to and downstream from Oceanview Farm (site INP) had significantly higher SS

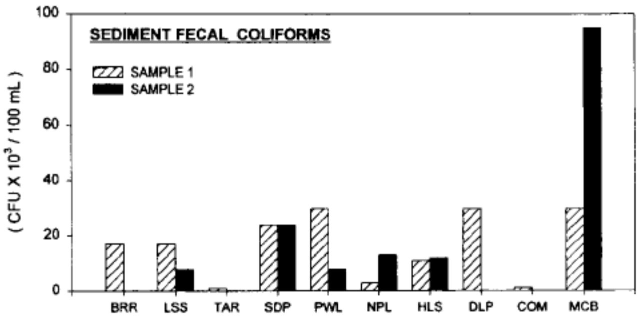

Fig. 6. Fecal coliform densities in the upper 2 cm of sediment slurry 14 d after the swine effluent spill, from sites in the known affected area. In consideration of the high heterogeneity of samples within a given site (stream length = 30 m), samples are plotted individually. Note that only one sample was taken at sites BRR and DLP.

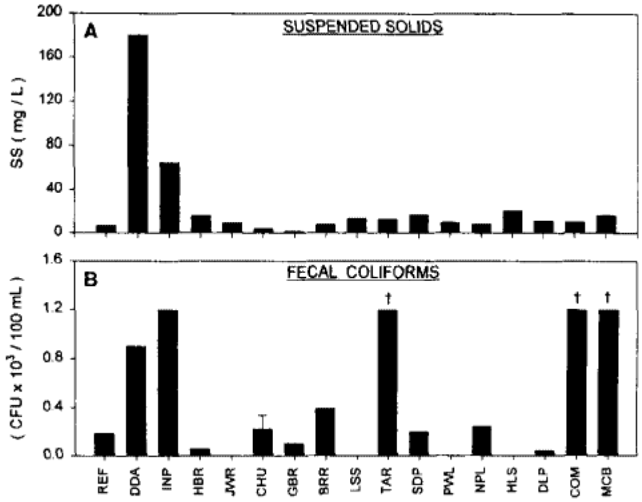

Fig. 7. (*A*) Suspended solids concentrations and (*B*) water-column fecal coliform densities 61 d after the swine effluent spill, with the line indicating the state standard for human health safety at 200 cfu/100 mL (NCDEHNR, 1996). Data are given as in Fig. 2; note that † = too numerous to count with the dilution used, $>10^3$ cfu/100 mL.

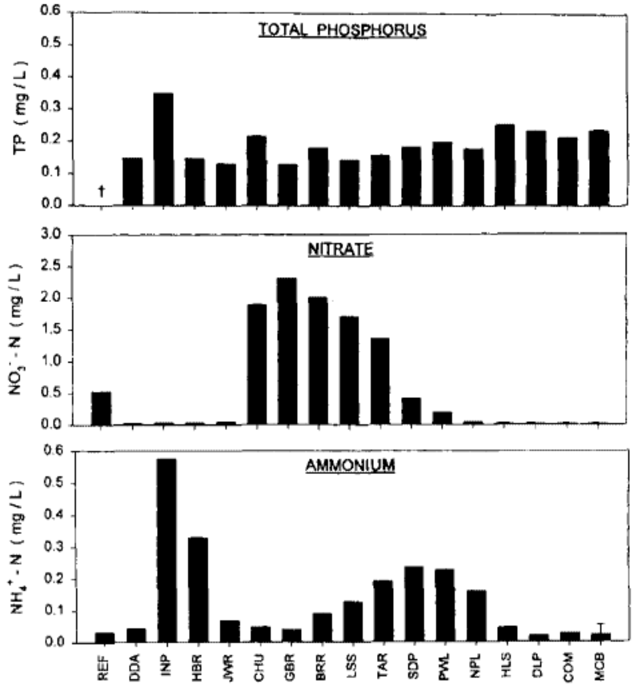

Fig. 8. Nutrient concentrations 61 d after the swine effluent spill, showing sites that were in the affected area by that time. Data are given as in Fig. 3; note that † = data not available.

concentrations than site REF or other downstream stations (Fig. 7). In fact, SS content at site DDA (ca. 180 mg SS/L) was more than twice that measured at the leading edge of the effluent plume from Oceanview Farm a short time after the June spill, indicating that the upstream CAO also was a substantial pollutant source to the upper New River.

Water column fecal coliform densities after the spill were highly variable, with freshwater stations DDA and INP exceeding 1.2×10^3 cfu/100 mL (Fig. 7B). These sites as well as stations CHU and BRR were in violation of the state standard for human health protection. These data indicated that at 61 d after the spill, pollutants contributed by drainage from the Oceanview Farm swine waste lagoon, while detectable, were sufficiently low that other pollutant sources farther downstream also could be detected. By contrast, shortly after the spill from this CAO, the monitored New River freshwater segments all reflected the influence of the swine effluent plume that had been easily discerned as it slowly moved downstream.

Nutrients TP and NH_4^+-N were significantly higher in the drainage ditch (DDA) of the CAO adjacent to the REF site than in any other site monitored during late August (Fig. 8). Ammonium was much lower than values measured during June to July, with most sites at >0.30 mg NH_4^+-N/L. Maxima ranging from 0.33 to 0.57 mg NH_4^+-N/L occurred at sites INP–HBR by Oceanview Farm. Total P ranged from 0.13 to 0.29 mg/L in most areas upstream from estuarine site HLS, with maximum TP recorded at site INP by Oceanview Farm (0.35 mg/L). Nitrate was low in freshwater areas (<0.1 mg NO_3^--N/L) until reaching stations CHU–BRR, where it increased to ca. 2.3 mg/L. A cluster of stations encompassing the fresh–brackish water transition were associated with elevated nitrate, and these stations were at an appreciable distance downstream from the Oceanview swine operation. This trend in the NH_4^+-N vs. NO_3^--N data suggests that (i) freshwater station CHU had contributed additional NO_3^- to the system, and/or (ii) a portion of high N inputs from upstream were decomposed–oxidized and converted to NO_3^- during downstream transport, which is consistent with trends in earlier data from the Oceanview Farm effluent spill.

Impacts to the Estuary

The New River Estuary below Wilson Bay (WLB) was not noticeably affected by the raw swine effluent until the plume reached the area 5 d after the spill, as previously indicated. We sampled nine stations from site JAX where the estuary opened and widened, downstream well into the mesohaline estuary on five dates from late June to late August. A dissolved oxygen sag was apparent in the upper stations post-spill, with surface DO levels at 4 mg/L, through 5 July down to channel marker M52 in the JAX vicinity. Bottom water was at or near anoxia from MCB down to M43 (channel marker M43 near Wallace Creek), except for site JAX where an algal bloom had elevated daytime DO levels throughout the water column (Table 5). Various wastewater discharges into the estuary, together with the higher volume for dilution, made the swine effluent spill difficult to track using DO after 5 July. However, elevated chl*a* levels were evident at JAX below the JWWTP after this 2-wk lag period (Table 6). During the previous summer, the phytoplankton community at JAX had consisted primarily of small coccoid blue-green algae (Cyanophyceae, or cyanobacteria) and dinoflagellates (authors' unpublished data). Blue-greens were 100-fold higher at JAX in summer 1995 after the swine effluent spill (*Synechococcus* and others; densities ca. 10^6 cells/mL and 10^8 cells/mL, respectively, in July 1994 and July 1995).

Down-estuary at site MGN, chl*a* averaged 110 μg/L by 5 July, which was substantially higher than the state

Table 6. Mean chlorophyll *a* concentrations (μg/L) in the New River and its upper estuary following the swine effluent spill (stations presented from upstream to downstream, left to right). Note that replicate samples yielded chlorophyll concentrations that were similar to within ±5%.

Date	MCB	UWL	JAX	MGN	HDN	FRC
June	51	74	78	‡	42	30
July	13	20	58	110	27	‡
July	‡	‡	327	‡	56	77
Aug.	‡	‡	64	43	117	167
Sept.	‡	‡	87	‡	25	22

† Note that sites MGN, HDN, and FRC (Morgan Bay, Hadnot Point, and French's Creek, respectively) were downstream from site JAX.
‡ Data not available.

standard for acceptable water quality (≤40 μg chl*a*/L; NCDEHNR, 1996; Table 6). The surface water had a brownish tinge from algal growth, notably a bloom of the harmful species, *Phaeocystis globosa* Scherffel (Lancelot et al., 1987; Savage, 1932), with gelatinous colonies that reached densities of $>10^6$ cells/mL. This alga, known to respond to high anthropogenic nutrient loading from sewage and other sources (Riegman et al., 1993), had not been reported previously from the New River Estuary (authors' unpublished data; NCDWQ records).

Two toxic heterotrophic dinoflagellates, *Pfiesteria piscicida* Steidinger & Burkholder and a second toxic *Pfiesteria*-like species (toxicity confirmed in bioassays with fish), also increased at sites NEC–MGN (Northeast Creek–Morgan Bay). For 10 mo before the study, zoospores of these dinoflagellates had maintained densities at $\leq 1 \times 10^2$ cells/mL, and were usually $<0.5 \times 10^2$ cells/mL. Shortly after the swine effluent spill (by Day 14), the zoospores had increased to 1.2×10^3 cells/mL, well above levels that are considered potentially lethal to fish (Burkholder et al., 1995). On 11 July (20 d after the spill), and despite acceptable DO and NH_4^+ levels, a fish kill occurred just upstream from Morgan Bay. Many of the affected, freshly dead fish (estimated count at >10 000) were found with open, bleeding cloacal ulcerations. Such sores are characteristic of *Pfiesteria* among other potential sources (Burkholder et al., 1995; Noga et al., 1996). We found large toxic amoeboid stages as well as zoospores of *P. piscicida* and the second toxic *Pfiesteria*-like species in the vicinity of the kill. The specific amoeboid stages are known to be produced when these dinoflagellates have been actively ichthyotoxic (Burkholder and Glasgow, 1995), implicating the toxic *Pfiesteria* complex as major causative of the kill. *Pfiesteria*-like species are known to be stimulated by P and N enrichments, both directly via organic sources and indirectly through stimulation of algal prey (Burkholder et al., 1992b; Burkholder and Glasgow, 1997; Burkholder et al., 1997).

The chl*a* levels remained high from JAX–MGN through July, as evidenced by oxygen bubbles from photosynthesis at the water surface and a brownish tinge from algal growth. At JAX in late July, chl*a* reached 327 μg/L and there was still a near-surface DO sag only in that station (depth 1.0 m; Tables 6 and 7). During the previous 10 mo including high-precipitation periods, chl*a* had not exceeded ca. 210 μg/L in that site, even during JWWTP malfunctions (mean ±1 SE from the previous 10 mo through July, 104 ± 26 μg/L). By late August, blooms dominated by dinoflagellates (*Prorocentrum minimum* [Pavillard] Schiller, gymnodinoid (non-*Pfiesteria*-like) dinoflagellates, and *Gyrodinium aureolum* Holburt) and euglenoids (*Euglena* sp.) had developed farther down-estuary (sites HDN–FRC; Table 6).

The estuarine water column was last sampled for short-term impacts 61 d after the spill (21 August). A slight salt wedge with 2.5 psu salinity in the bottom water at site TAR, and a more pronounced salt wedge downstream from that station (e.g., bottom water with 5.8 psu at site LSS), indicated that the relatively low precipitation period of the previous weeks had allowed

Table 7. Environmental conditions in the New River and its estuary on 24 July 1995, ca. 31 d after the swine effluent spill. Stations are listed proceeding from upstream down toward the estuary's confluence with the Atlantic Ocean.†

Station	Depth	Temp.	DO	Salinity	Sp. Cond.	pH	Secchi	Turbidity
	m	°C	mg/L	psu	μS/cm²		m	jtu
JAX	0.2	33.1	13.0	4.0	7.1	8.7	0.4	14.2
	1.0	31.3	1.8	6.3	10.0	7.6		14.4
	2.0	31.1	0.1	9.8	16.7	7.3		9.4
NEC	0.2	33.0	8.0	9.3	16.0	8.4	0.4	16.6
	2.5	33.1	8.0	9.3	16.0	8.4		19.0
MGN	0.2	32.3	7.4	11.0	18.6	8.4	‡	7.4
	1.0	32.0	6.8	11.2	18.9	8.3		7.9
	2.0	31.1	4.0	12.5	21.0	7.9		6.7
	3.0	31.0	2.3	13.1	21.8	7.7		8.0
M43	0.2	32.1	6.8	12.3	20.6	8.3	‡	9.1
	1.0	31.0	3.8	14.1	23.5	8.0		7.8
	2.0	31.0	2.5	14.6	24.1	7.9		11.0
	3.0	31.0	2.4	14.8	24.5	7.9		19.0
WLC	0.2	32.8	8.4	11.5	19.3	8.5	0.8 (B)	16.6
	0.8	32.6	8.2	11.4	19.3	8.4		19.0
HDN	0.2	32.6	9.2	14.0	23.3	8.5	0.6 (B)	15.1
	0.6	32.6	9.2	14.0	23.3	8.5		20.5
FRC	0.2	32.3	9.8	15.2	25.1	8.6	0.7 (B)	12.2
	0.7	32.6	9.4	15.1	25.0	8.6		14.3
SNF	0.2	32.0	7.6	23.6	37.4	8.1	0.8	11.6
	0.7	31.6	6.5	24.5	38.8	8.1		13.4

† Last water-column measurements taken at ca. 0.2 m from the bottom sediments.
‡ Data not available.

estuarine influence to extend considerably farther upriver than previously detected. The estuarine sites at Day 61 included five sites (LSS–NPL) that had been within the freshwater area affected by the plume on the first sampling state.

Suspended solids concentrations at 61 d after the spill were low throughout the estuarine stations that were sampled. Water-column fecal coliform densities were highly variable, with sites LAR, COM, and MCB exceeding 1.2×10^3 cfu/100 mL (Fig. 7B). These sites as well as stations SDP and NPL were in violation of the state standard for human health protection. Nutrient concentrations in estuarine areas generally were low, with exception of NO_3^-, which was highest at stations LSS–LAR (1.2–1.7 mg NO_3^-–N/L; Fig. 8).

By late August, 5 of the 10 sites that were examined for surficial sediment fecal coliform densities, which were at 1.0 to 7.5×10^2 cfu/100mL sediment slurry (or 7 to 49×10^2 cfu/100 g wet sediment), with remaining locations 10-fold higher (1.8 to 5.2×10^3 cfu/100 mL sediment slurry, or 1.2 to 1.4×10^4 cfu/100 g wet sediment; overlying water depth 1–3 m; Fig. 9). In the shallow river habitat, these bacteria and associated microbial pathogens potentially could have been redistributed into the water column following storm activity or other mild disturbance of surficial sediments (e.g., Davies et al., 1995; Sherer et al., 1988; Rose and Lipp, 1997).

DISCUSSION

This report presents the first known published study on acute surface water quality impacts from a massive swine effluent spill. We documented severe impacts of effluent from a ruptured swine waste holding lagoon on dissolved oxygen levels in receiving surface waters. Toxic levels of NH_4^+–N for fish were measured (McKee and Wolf 1963), which also represented a source of N to support algal blooms in this N-limited system (Mallin et al., 1997b). We also found high P, high suspended solids, and extremely high fecal coliforms (more than 15 000-fold higher than the state standard) that were indicative of the presence of microorganisms that are deleterious to human health. Extensive fish death occurred, considering the size of the small freshwater segments that first received the effluent. Algal production

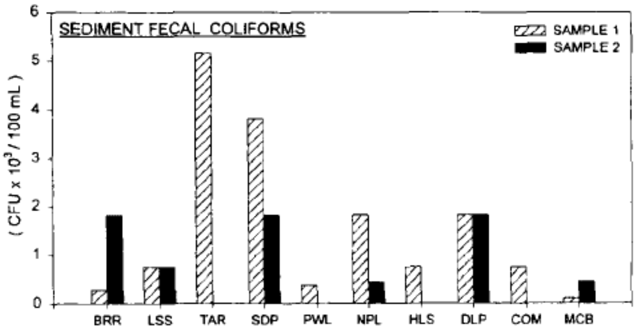

Fig. 9. Fecal coliform densities in the upper 2 cm of sediment slurry 61 d after the swine effluent spill, from sites in the known affected area. Data are given as in Fig. 6; note that only one sample was taken at sites TAR, HLS, and COM.

increased to levels that exceeded the state standard by up to eightfold, with impacts down-estuary that apparently extended through much of the summer growing season. Among these plankton, freshwater/brackish blue-greens and three mesohaline organisms known to be harmful to fish were stimulated to bloom.

In areas known to have been affected by fecal material or spills, the sediments commonly contain 100- to 1000-fold more fecal indicator bacteria than the overlying water (Ashbolt et al., 1993; Davies et al., 1995). Indicator bacteria and viruses of fecal contamination accumulate in sediments, attributed to the sorption of these microorganisms to particles that settle out of the water (Davies et al., 1995; Pommepuy et al., 1992). The period of microbial pathogen survival in the sediments of areas impacted by waste spills or discharges is a recognized concern to regulatory authorities in some states (e.g., Rose and Lipp, 1997) as well as other countries (e.g., Davies et al., 1995), although thus far not in North Carolina (Samolinski, 1995). Public health risks are associated with the accumulation of these pathogen indicators in sediments, especially where they can be resuspended into waters used for recreation, fisheries, and potable supplies (Davies et al., 1995; Rose and Lipp, 1997).

Sediment resuspension from wind and wave action is common in the shallow sites sampled in the New River and its estuary, where the swine effluent plume was documented to have hovered for more than a week. Fecal bacteria adsorbed to sediment particles likely derived sediment-associated nutrients, and would have been somewhat protected from ultraviolet light, certain toxicants, and viral attack (but not from some benthic predators; Davies et al., 1995; Springthorpe et al., 1993). The sediment fecal bacteria measured in this study appeared to decrease slowly over time as expected (Davies et al., 1995; Howell et al., 1996), although in certain sites (e.g., site CHU, also affected by agricultural crop field activity) their numbers could have been augmented over time by other sources. Potential human health risk thus was indicated by high densities of sediment fecal bacteria. Contamination of sediments by microbial pathogens, nutrients, and organic materials in the swine waste, and the physical burial effect of deposited solids, also probably altered the benthic environment to make it less conducive to spawning for subsequent fish year classes (B. Freeman, director, NCDMF, personal communication; A. Little, North Carolina Wildlife Resources Commission, 1995, personal communication). Such long-term or chronic impacts from this animal waste spill cannot be determined, however, from the present study.

The timing of this spill, preceeding a major summer holiday, created unforeseen hardship on local tourism and fishing. Marinas in the city of Jacksonville were coated with brown, foul-smelling material, and potential tourists and fishermen who heard about the spill avoided coming to the area (Leavenworth, 1995). It was estimated that the loss from this spill for the recreational fishing industry alone was $4 million (including economic *halo* effects on motels, restaurants, etc.; K. Smith, economist, Duke University, unpublished data). The swine industry provides more than $1 billion for North Carolina's economy, whereas fishing activities contribute an estimated $6 billion (NCDMF, 1993; NCDA, 1996). Although this spill led to a fish kill mostly of small, nonmarketable fish, the potential impacts of surface water quality deterioration to fishing and coastal tourism from animal waste spills are substantial.

Winkler et al. (1995) wrote,

> The introduction of potentially harmful bacteria into the environment requires analysis and monitoring of microbial population dynamics to define persistence and activity from both efficacy and risk assessment perspectives.

Impacts to water quality for human use from animal waste and other sewage spills need to be evaluated on the basis of data other than water-column fecal coliform densities (e.g., Cavari and Bergstein, 1986; Davies et al., 1995; Dutka, 1973; Payment and Franco, 1993; Roszack et al., 1984; Sherer et al., 1988, 1992). The state of Florida, for example, is beginning to evaluate surficial sediment fecal coliform concentrations in determining when it is safe for humans to have direct contact with a waters that are known to have sustained a sewage spill (D. Tomasko, Southwest Florida Water Management District, 1995, personal communication; Rose and Lipp, 1997). In contrast, when reopening the New River to human contact after the swine effluent spill characterized in this study (e.g., wading by concerned citizens in cleanup efforts), health officials in NCDEHNR used only water-column fecal coliform densities as a safety criterion (M. Moser, NCDEHNR, 1995, personal communication). Sediment fecal coliform densities in the known impacted area, and the potential for their resuspension, were not considered; data on other microbial pathogens were not obtained; and there was no follow-up of people who waded or otherwise had direct contact with the river after it was reopened to human contact (M. Moser, NCDEHNR, personal communication; Samolinski, 1995).

Air quality impacts from these operations also are considered to be substantial (e.g., up to 80% of the total NH_4^+-N in the wastes is released to the atmosphere from accepted spraying practices, much of which enters waterways as local precipitation; Nielson et al., 1988). Such airborne impacts should be assessed on the basis of chronic impacts to aquatic biota (e.g, from NH_4^+-N emissions that can contribute locally to loadings of nutrients such as N) and human health (e.g., from viruses and other microbial pathogens carried in air from spray fields, some of which could locally impact surface waters; Nielson et al., 1988).

The Oceanview CAO swine effluent spill, and the data that characterized it, were important in focusing public attention in North Carolina on water quality impacts from animal waste operations, which were predicted several months earlier from a Pulitzer prize-winning series in a major state newspaper (Stith and Warrick, 1995). This spill coincided with a previously planned national workshop that contributed a careful evaluation of research needed to assess environmental impacts of large-scale swine production (Thu, 1996). A Blue Ribbon Committee on Animal Wastes was appointed by the governor of North Carolina after the Oceanview spill and other mismanaged CAO waste discharges. Its charge was to provide recommendations about more effective waste management; the committee did not consider data for surface water impacts from documented spills. An animal waste research facility was created to act as a clearinghouse to facilitate science–industry partnerships in developing value-added, marketable products from the wastes (Williams, 1996). Such activity likely will prove to be productive in efforts to reduce animal waste impacts to receiving surface waters, since the industry is a willing partner.

The NCDWQ was allowed to inspect all CAOs in the state during late summer to fall 1995, following several other large waste lagoon spills. The agency found ca. 20% of the ca. 4000 operations in violation of existing regulations (North Carolina Coastal Fed., 1996, NCDWQ records). Impacts to surface waters and wetlands from about 5% of the inspected CAOs were assessed by NCDWQ as ongoing and severe, for example, a case wherein the operator had bypassed lagoon procedures and directly sprayed raw swine wastes to a swamp forest wetland for the previous 14 yr. In a ca. 25-ha area adjacent to that operation, trees had died and massive blooms of duckweed (*Lemna* spp.) and blue-green algae had developed. Other actions, such as attempts to provide NCDWQ with more authority in regulating waste management in concentrated swine production facilities, have met with sustained resistance from many in the swine industry, in part because of the punative rather than incentive nature of proposed regulations. Some industry leaders have increased self-regulation, and have imposed stiff penalties on their contract swine facility operators when found to be in violation of existing regulations.

Nonetheless, through summer 1996 some CAOs continued to operate with poor management of swine wastes, and CAOs continued to be constructed directly on wetland soils in locations drained for other uses before 1985 (North Carolina Coastal Fed., 1996). Notice of inadequate waste storage capacity and other violations legally cannot be supported by fines or other penalties and, so, remain ineffective as deterrents unless there is evidence of an actual spill (Warrick, 1996). In 1996 Hurricane Fran led to severe flooding of CAOs located in coastal river floodplains, and to rupture of various lagoons in several major watersheds (e.g., the Neuse and Cape Fear; NCDEHNR records). In 1997 some counties attempted to obtain a temporary moratorium on additional CAO development. The governor also supported legislation to impose a 2-yr moratorium on large intensive animal operations, in recognition of the fact that the industry has rapidly advanced beyond previously conceived state management strategies to handle potential and realized impacts from the contributed wastes.

Until recently, few data on acute surface water impacts from animal operations have been available, although concentrated swine operations have existed for the past decade and are increasing in North Carolina as well as in the midwestern and western USA. Participants of the previously mentioned national workshop to address impacts of large-scale swine production noted, similarly, that there has been "a surprising lack of information about environmental impacts of CAOs to adjacent lands and receiving waters" (Thu, 1996).

More serious, perhaps, than documented acute effects exemplified by this spill are impacts to surface waters from currently accepted practices that (i) utilize inadequate crop vegetation to absorb the sprayed wastes; or (ii) involve groundwater as an intermediate source via chronic seepage of sprayed effluent from lands with saturated soils or seepage through inadequately lined lagoons (McMahon and Lloyd, 1995; North Carolina Coastal Fed., 1996). Airborne contributions of NH_4^+–N and other pollutants from spray fields to local surface waters are regarded as substantial (e.g., Nielson et al., 1988). In addition, within the past several years empirical research has demonstrated that chronic, significant adverse impacts to both surface- and groundwater resources are contributed from standard CAO spraying practices—for example, as excessive nutrient loading (mg/L concentrations of N and P measured in receiving streams and adjacent groundwater supplies; e.g., Evans et al., 1984; Gilliam et al., 1996; Stone et al., 1995; Westerman et al., 1985a). Such impacts would be exaccerbated for operations in former wetlands or floodplains with porous soils over shallow water tables. This description characterizes North Carolina's coastal plain, where most of the state's intensive swine operations are located. Yet, CAOs remain classified by NCDWQ as *non-discharge* systems, without acknowledged contribution of N, P, or other pollutants to surface waters. Moreover, North Carolina's CAOs require import of massive quantities of N- and P-rich grains on a daily basis, with nutrient-sensitive watersheds serving as inadvertent sinks or collection areas for the nutrient-rich manures (mass balance study of L. Cahoon and colleagues, UNC-Wilmington, unpublished data; NCDA records).

Little is known of the extent to which other constituents of swine wastes affect aquatic biota (e.g., microbial pathogens, organic nutrients of use to noxious algae, heavy metals from feed, xenoestrogens; e.g., Burkholder, 1996; Dewi et al., 1994; Kofer, 1992; Slomp et al., 1993; Salmon et al., 1995; Thu, 1996; Welch, 1979). Further research is underway to examine the full extent of both acute and chronic impacts to surface waters from currently accepted practices of animal waste application, so that protocol modifications can be designed for adequate protection of adjacent and downstream surface water resources. These data are critically needed in areas such as the coastal plain and piedmont of North Carolina, where exponential growth of CAOs continued to be a reality for more than 1 yr following a series of leakage and spill events from CAOs (this study; Mallin et al., 1997a) (NCDA, 1996).

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Exhibit 3

Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality

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Waste from agricultural livestock operations has been a long-standing concern with respect to contamination of water resources, particularly in terms of nutrient pollution. However, the recent growth of concentrated animal feeding operations (CAFOs) presents a greater risk to water quality because of both the increased volume of waste and to contaminants that may be present (e.g., antibiotics and other veterinary drugs) that may have both environmental and public health importance. Based on available data, generally accepted livestock waste management practices do not adequately or effectively protect water resources from contamination with excessive nutrients, microbial pathogens, and pharmaceuticals present in the waste. Impacts on surface water sources and wildlife have been documented in many agricultural areas in the United States. Potential impacts on human and environmental health from long-term inadvertent exposure to water contaminated with pharmaceuticals and other compounds are a growing public concern. This workgroup, which is part of the Conference on Environmental Health Impacts of Concentrated Animal Feeding Operations: Anticipating Hazards—Searching for Solutions, identified needs for rigorous ecosystem monitoring in the vicinity of CAFOs and for improved characterization of major toxicants affecting the environment and human health. Last, there is a need to promote and enforce best practices to minimize inputs of nutrients and toxicants from CAFOs into freshwater and marine ecosystems. *Key words:* ecology, human health, poultry, swine, water contaminants, wildlife. *Environ Health Perspect* 115:308–312 (2007). doi:10.1289/ehp.8839 available via *http://dx.doi.org/* [Online 14 November 2006]

Background and Recent Developments

Concentrated animal feed operations and water quality. Animal cultivation in the United States produces 133 million tons of manure per year (on a dry weight basis) representing 13-fold more solid waste than human sanitary waste production [U.S. Environmental Protection Agency (U.S. EPA) 1998]. Since the 1950s (poultry) and the 1970s–1980s (cattle, swine), most animals are now produced for human consumption in concentrated animal feeding operations (CAFOs). In these industrialized operations, the animals are held throughout their lives at high densities in indoor stalls until they are transported to processing plants for slaughter. There is substantial documentation of major, ongoing impacts on aquatic resources from CAFOs, but many gaps in understanding remain.

Contaminants detected in waste and risk of water contamination. Contaminants from animal wastes can enter the environment through pathways such as through leakage from poorly constructed manure lagoons, or during major precipitation events resulting in either overflow of lagoons and runoff from recent applications of waste to farm fields, or atmospheric deposition followed by dry or wet fallout (Aneja 2003). The magnitude and direction of transport depend on factors such as soil properties, contaminant properties, hydraulic loading characteristics, and crop management practices (Huddleston 1996). Many contaminants are present in livestock wastes, including nutrients (Jongbloed and Lenis 1998), pathogens (Gerba and Smith 2005; Schets et al. 2005), veterinary pharmaceuticals (Boxall et al. 2003; Campagnolo et al. 2002; Meyer 2004), heavy metals [especially zinc and copper; e.g., Barker and Zublena (1995); University of Iowa and Iowa State Study Group (2002)], and naturally excreted hormones (Hanselman et al. 2003; Raman et al. 2004). Antibiotics are used extensively not only to treat or prevent microbial infection in animals (Kummerer 2004), but are also commonly used to promote more rapid growth in livestock (Cromwell 2002; Gaskins et al. 2002; Liu et al. 2005). In addition, pesticides such as dithiocarbamates are applied to sprayfields (Extension Toxicology Network 2003). Although anaerobic digestion of wastes in surface storage lagoons can effectively reduce or destroy many pathogens, substantial remaining densities of microbial pathogens in waste spills and seepage can contaminate receiving surface- and groundwaters (e.g., Burkholder et al. 1997; Mallin 2000). Pharmaceuticals can remain present as parent compounds or degradates in manure and leachates even during prolonged storage. Improper disposal of animal carcasses and abandoned livestock facilities can also contribute to water quality problems. Siting of livestock operations in areas prone to flooding or where there is a shallow water table increases the potential for environmental contamination.

The nutrient content of the wastes can be a desirable factor for land application as fertilizer for row crops, but overapplication of livestock wastes can overload soils with both macronutrients such as nitrogen (N) and phosphorous (P), and heavy metals added to feed as micronutrients (e.g., Barker and Zublena 1995). Overapplication of animal wastes or application of animal wastes to saturated soils can also cause contaminants to move into receiving waters through runoff and to leach through permeable soils to vulnerable aquifers. Importantly, this may happen even at recommended application rates. As examples, Westerman et al. (1995) found 3–6 mg nitrate (NO_3)/L in surface runoff from sprayfields that received swine effluent at recommended rates; Stone et al. (1995) measured 6–8 mg total inorganic N/L and 0.7–1.3 mg P/L in a stream adjacent to swine effluent sprayfields. Evans et al. (1984) reported 7–30 mg NO_3/L in subsurface flow draining a sprayfield for swine wastes, applied at recommended rates. Ham and DeSutter (2000) described export rates of up to 0.52 kg ammonium m^{-2} $year^{-1}$ from lagoon seepage; Huffman and Westerman (1995) reported that groundwater near swine waste lagoons averaged 143 mg inorganic N/L, and estimated export rates at 4.5 kg inorganic N/day. Thus, nutrient losses into receiving waters can be excessive relative to levels (~ 100–200 µg inorganic N or P/L)

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known to support noxious algal blooms (Mallin 2000). In addition to contaminant chemical properties, soil properties and climatic conditions can affect transport of contaminants. For example, sandy, well-drained soils are most vulnerable to transport of nutrients to underlying groundwater (Mueller et al. 1995). Nutrients can also readily move through soils under wet conditions (McGechan et al. 2005).

Presence of contaminants in water sources. The presence of many contaminants from livestock waste has been documented in both surface water and groundwater supplies in agricultural areas within the United States (e.g., Campagnolo et al. 2002; Kolpin et al. 2002; Meyer 2004). Urban wastewater streams also contain these contaminants, and efforts to accurately determine sources of contamination are under way (Barnes et al. 2004; Cordy et al. 2004; Kolpin DW, unpublished data). The U.S. Geological Survey (USGS) began pilot surveillance programs for organic wastewater contaminants in 1999 and expanded that effort to a national scale over the past 5 years (Kolpin et al. 2002). Recent USGS efforts have focused specifically on water quality in agricultural locations (Kolpin DW, unpublished data). Nutrient levels have been detected in high parts per million (milligrams per liter) levels; pharmaceuticals and other compounds are generally measured in low levels (ppb [micrograms per liter]). In Europe, surveillance efforts conducted in Germany documented the presence of veterinary pharmaceuticals in water resources (Hirsch et al. 1999).

Animal wastes are also rich in organics and high in biochemical oxygen-demanding materials (BOD); for example, treated human sewage contains 20–60 mg BOD/L, raw sewage contains 300–400 mg BOD/L, and swine waste slurry contains 20,000–30,000 mg BOD/L (Webb and Archer 1994). Animal wastes also carry parasites, viruses, and bacteria as high as 1 billion/g (U.S. EPA 1998). Swine wastes contain > 100 microbial pathogens that can cause human illness and disease [see review in Burkholder et al. (1997)]. About one-third of the antibiotics used in the United States each year is routinely added to animal feed to increase growth (Mellon et al. 2001). This practice is promoting increased antibiotic resistance among the microbial populations present and, potentially, increased resistance of naturally occurring pathogens in surface waters that receive a portion of the wastes.

Contaminant impacts. Some contaminants pose risks for adverse health impacts in wildlife or humans. The effects of numerous waterborne pathogens on humans are well known, although little is known about potential impacts of such microorganisms on aquatic life. With respect to nutrients, excessive phosphorus levels can contribute to algal blooms and cyanobacterial growth in surface waters used for recreation and as sources of drinking water. Research is beginning to investigate the environmental effects, including endocrine disruption and antibiotic resistance issues (Burnison et al. 2003; Delepee et al. 2004; Fernandez et al. 2004; Halling-Sorensen et al. 2003; Sengelov et al. 2003; Soto et al. 2004; Wollenberger et al. 2000). However, knowledge is limited in several crucial areas. These areas include information on metabolites or environmental degradates of some parent compounds; the environmental persistence, fate, and transport and toxicity of metabolites or degradates (Boxall et al. 2004); the potential synergistic effects of various mixtures of contaminants on target organisms (Sumpter and Johnson 2005); and the potential transport and effects from natural and synthetic hormones (Hanselman et al. 2003; Soto et al. 2004). Further, limited monitoring has been conducted of ecosystem health in proximity to CAFOs, including monitoring the effects on habitats from lagoon spills during catastrophic flooding (Burkholder et al. 1997; Mallin et al. 1997; Mallin et al. 2000).

Ecologic and wildlife impacts. Anoxic conditions and extremely high concentrations of ammonium, total phosphorus, suspended solids, and fecal coliform bacteria throughout the water column for approximately 30 km downstream from the point of entry have been documented as impacts of waste effluent spills from CAFOs (Burkholder et al. 1997; Mallin et al. 2000). Pathogenic microorganisms such as *Clostridium perfringens* have been documented at high densities in receiving surface waters following CAFO waste spills (Burkholder et al. 1997). These degraded conditions, especially the associated hypoxia/anoxia and high ammonia, have caused major kills of freshwater fish of all species in the affected areas, from minnows and gar to largemouth bass, and estuarine fish, including striped bass and flounder (Burkholder et al. 1997). Waste effluent spills also stimulated blooms of toxic and noxious algae. In freshwaters, these blooms include toxic and noxious cyanobacteria while in estuaries, harmful haptophytes and toxic dinoflagellates arise. Most states monitor only water-column fecal coliform densities to assess whether waterways are safe for human contact. World Health Organization (WHO) guidelines for cyanobacteria in recreational water are 20,000 cyanobacterial cells/mL, which indicates low probability of adverse health effects, and 100,000 cyanobacterial cells/mL, which indicates moderate probability of adverse health effects (WHO 2003). Yet fecal bacteria and other pathogenic microorganisms typically settle out to the sediments where they can thrive at high densities for weeks to months following CAFO waste effluent spills (Burkholder et al. 1997).

The impacts from CAFO pollutant loadings to direct runoff are more substantial after such major effluent spills or when CAFOs are flooded and in direct contact with surface waters (Wing et al. 2002). Although the acute impacts are often clearly visible—dead fish floating on the water surface, or algal overgrowth and rotting biomass—the chronic, insidious, long-term impacts of commonly accepted practices of CAFO waste management on receiving aquatic ecosystems are also significant (U.S. EPA 1998). One purpose of manure storage basins is to reduce the N content of the manure through volatilization of ammonia and other N-containing molecules. Many studies have shown, for example, that high nutrient concentrations (e.g., ammonia from swine CAFOs, or ammonia oxidized to NO_3, or phosphorus from poultry CAFOs) commonly move off-site to contaminate the overlying air and/or adjacent surface and subsurface waters (Aneja et al. 2003; Evans et al. 1984; Sharpe and Harper 1997; Sharpley and Moyer 2000; Stone et al. 1995; U.S. EPA 1998; Webb and Archer 1994; Westerman et al. 1995; Zahn et al. 1997). Inorganic N forms are added to the atmosphere during spray practices, and both ammonia and phosphate can also adsorb to fine particles (dust) that can be airborne. The atmospheric depositions are noteworthy, considering that a significant proportion of the total ammonium from uncovered swine effluent lagoons and effluent spraying (an accepted practice in some states) reenters surface waters as local precipitation or through dry fallout (Aneja et al. 2003; U.S. EPA 1998, 2000). The contributed nutrient concentrations from the effluent greatly exceed the minimal levels that have been shown to promote noxious algal blooms (Mallin 2000) and depress the growth of desirable aquatic habitat species (Burkholder et al. 1992). The resulting chronically degraded conditions of nutrient overenrichment, while not as extreme as during a major waste spill, stimulate algal blooms and long-term shifts in phytoplankton community structure from desirable species (e.g., diatoms) to noxious species.

A summary of the findings from a national workshop on environmental impacts of CAFOs a decade ago stated that there was "a surprising lack of information about environmental impacts of CAFOs to adjacent lands and receiving waters" (Thu K, Donham K, unpublished data). Although the knowledge base has expanded since that time, especially regarding adverse effects of inorganic N and P overenrichment and anoxia, impacts of many CAFO pollutants on receiving aquatic ecosystems remain poorly understood. As examples, there is poor understanding of the impacts of fecal bacteria and other microbial pathogens from CAFO waste effluent contamination on aquatic communities; impacts of antibiotic-resistant bacteria created from CAFO wastes on aquatic life; impacts of organic nutrient forms preferred by certain noxious plankton; impacts from the contributed pesticides and heavy metals; and impacts from these pollutants acting in concert, additively or synergistically. This lack of information represents a critical gap in our present ability to assess the full extent of CAFO impacts on aquatic natural resources.

Despite their widespread use, antibiotics have only recently received attention as environmental contaminants. Most antibiotics are designed to be quickly excreted from the treated organism. Thus, it is not surprising that antibiotics are commonly found in human and animal waste (Christian et al. 2003; Dietze et al. 2005; Glassmeyer et al. 2005; Meyer 2004) and in water resources affected by sources of waste (Glassmeyer et al. 2005; Kolpin et al. 2002). Although some research has been conducted on the environmental effects from antibiotics (e.g., Brain et al. 2005; Jensen et al. 2003), much is yet to be understood pertaining to long-term exposures to low levels of antibiotics (both individually and as part of complex mixtures of organic contaminants in the environment). The greatest risks appear to be related to antibiotic resistance (Khachatourians 1998; Kummerer 2004) and natural ecosystem functions such as soil microbial activity and bacterial denitrification (Costanzo et al. 2005; Thiele-Bruhn and Beck 2005).

Human health impacts. Exposure to waterborne contaminants can result from both recreational use of affected surface water and from ingestion of drinking water derived from either contaminated surface water or groundwater. High-risk populations are generally the very young, the elderly, pregnant women, and immunocompromised individuals. Recreational exposures and illnesses include accidental ingestion of contaminated water that may result in diarrhea or other gastrointestinal tract distress from waterborne pathogens, and dermal contact during swimming that may cause skin, eye, or ear infections. Drinking water exposures to pathogens could occur in vulnerable private wells; under normal circumstances community water utilities disinfect water sufficiently before distribution to customers. Cyanobacteria (blue–green algae) in surface water can produce toxins (e.g., microcystins) that are known neurotoxins and hepatotoxins. Acute and chronic health impacts from these toxins can occur from exposures to both raw water and treated water (Carmichael et al. 2001; Rao et al. 2002). Removal of cyanotoxins during drinking water treatment is a high priority for the drinking water industry (Hitzfield et al. 2000; Rapala et al. 2002). The WHO has set a provisional drinking water guideline of 1 µg microcystin-LR/L (Chorus and Bartram 1999). While there are no drinking water standards in the United States for cyanobacteria, they are on the U.S. EPA Unregulated Contaminant Monitoring Rule List 3 (U.S. EPA 2006).

Exposure to chemical contaminants can occur in both private wells and community water supplies, and may present health risks. High nitrate levels in water used in mixing infant formula have been associated with risk for methemoglobinemia (blue-baby syndrome) in infants under 6 months of age, although other health factors such as diarrhea and respiratory disease have also been implicated (Ward et al. 2005). The U.S. EPA drinking water standard of 10 mg/L NO_3–N and the WHO guideline of 11 mg/L NO_3–N were set because of concerns about methemoglobinemia. (Note: "nitrate" refers to nitrate–nitrogen). Epidemiologic studies of noncancer health outcomes and high nitrate levels in drinking water have reported an increased risk of hyperthyroidism (Seffner 1995) from long-term exposure to levels between 11–61 mg/L (Tajtakova et al. 2006). Drinking water nitrate at levels < 10 mg/L has been associated with insulin-dependent diabetes (IDDM; Kostraba et al. 1992), whereas other studies have shown an association with IDDM at nitrate levels > 15 mg/L (Parslow et al. 1997) and > 25 mg/L (van Maanen et al. 2000). Increased risks for adverse reproductive outcomes, including central nervous system malformations (Arbuckle et al. 1988) and neural tube defects (Brender et al. 2004; Croen et al. 2001), have been reported for drinking water nitrate levels < 10 mg/L.

Anecdotal reports of reproductive effects of nitrate in drinking water include a case study of spontaneous abortions in women consuming high nitrate water (19–26 mg/L) from private wells (Morbidity and Mortality Weekly Report 1996).

While amassing experimental data suggest a role for nitrate in the formation of carcinogenic *N*-nitroso compounds, clear epidemiologic findings are lacking on the possible association of nitrate in drinking water with cancer risk. Ecologic studies have reported mixed results for cancers of the stomach, bladder, and esophagus (Barrett et al. 1998; Cantor 1997; Eicholzer and Gutzwiller 1990; Morales-Suarez-Varela et al. 1993, 1995) and non-Hodgkin lymphoma (Jensen 1982; Weisenburger 1993), positive findings for cancers of the nasopharynx (Cantor 1997), prostate (Cantor 1997), uterus (Jensen 1982; Thouez et al. 1981), and brain (Barrett et al. 1998), and negative findings for ovarian cancer (Jensen 1982; Thouez et al. 1981). Positive findings have generally been for long-term exposures at > 10 mg/L nitrate. Case–control studies have reported mixed results for stomach cancer (Cuello et al. 1976; Rademacher et al. 1992; Yang et al. 1998); positive results for non-Hodgkin lymphoma at > 4 mg/L nitrate (Ward et al. 1996) and colon cancer at > 5 mg/L (De Roos et al. 2003); and negative results for cancers of the brain (Mueller et al. 2001; Steindorf et al. 1994), bladder (Ward et al. 2003), and rectum (De Roos et al. 2003), all at < 10 mg/L. Cohort studies have reported no association between nitrate in drinking water and stomach cancer (Van Loon et al. 1998); positive associations with cancers of the bladder and ovary at long-term exposures > 2.5 mg/L (Weyer et al. 2001); and inverse associations with cancers of the rectum and uterus, again at > 2.5 mg/L (Weyer et al. 2001).

Exposure to low levels of antibiotics and other pharmaceuticals in drinking water (generally at micrograms per liter or nanograms per liter) represent unintentional doses of substances generally used for medical purposes to treat active disease or prevent disease. The concern is more related to possible cumulative effects of long-term low-dose exposures than on acute health effects (Daughton and Ternes 1999). A recent study conducted in Germany found that the margin between indirect daily exposure via drinking water and daily therapeutic dose was at least three orders of magnitude, concluding that exposure to pharmaceuticals via drinking water is not a major health concern (Webb et al. 2003). It should be noted that when prescribing medications, providers ensure patients are not taking incompatible drugs, but exposure via drinking water is beyond their control.

Endocrine-disrupting compounds are chemicals that exhibit biological hormonal activity, either by mimicking natural estrogens, by canceling or blocking hormonal actions, or by altering how natural hormones and their protein receptors are made (McLachlan and Korach 1995). Although very low levels of estrogenic compounds can stimulate cell activity, the potential for human health effects, such as breast and prostate cancers, and reproductive effects from exposure to endocrine disruptors, is in debate (Weyer and Riley 2001).

Workshop Recommendations

Priority research needs.

- Ecosystems monitoring: Systematic sustained studies of ecosystem health in proximity to large CAFOs are needed, including effects of input spikes during spills or flooding events.
- Toxicologic assessment of contaminants: Identification and prioritization of contaminants are needed to identify those that are most significant to environmental and public health. Toxicity studies need to be conducted to identify and quantify contaminants

(including metabolites), and to investigate interactions (synergistic, additive, and antagonistic effects).

- Fate and transport: Studies of parent compounds and metabolites in soil and water must be conducted, and the role of sediment as a carrier and reservoir of contaminants must be evaluated.
- Surveillance programs: Programs should be instituted to assess private well water quality in high-risk areas. Biomonitoring programs should be designed and implemented to assess actual dose from environmental exposures.

Translation of science to policy.

- Wastewater and drinking water treatment: Processes for water treatment must be monitored to ensure adequate removal or inactivation of emerging contaminants.
- Pollution prevention: Best management practices should be implemented to prevent or minimize release of contaminants into the environment.
- Education: Educational materials should be continued to be developed and distributed to agricultural producers.

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Exhibit 15

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise stated.

Background

2. I am African-American. I live at [redacted] (See Attached Map). I am [redacted] years old and I am a retired CNA (Certified Nursing Assistant).

3. I own my property. It is located near a hog facility. The closest hog farm is about half a mile away. There is also a poultry facility about half a mile away as well. I have lived near the hog facility ever since it was built here, about ten to fifteen years ago, if not longer.

4. There are two other members of my current household, [redacted] who is [redacted] years old, and [redacted]ho is [redacted] years old.

5. Other people have lived in this household and may have been affected by the hog facility, including [redacted]

Experience Living Near the Hog Facilities

6. When the facility sprays, the odor is really bad for three days. The smell of the hog facility makes me sick. The smell attracts flies also, which are really bad.

7. When the facility is spraying, or for the days following; I can't raise the windows. We can't cook outdoors or do anything in the yard when the smell is present. For example, I can't hang my clothes outside to dry because the smell will get in the clothes. I spend a lot of time in my garden, and I don't like to be out there when the smell comes. I also don't like being on the porch when the smell comes; it's difficult to sit on the porch when I have to fight flies all the time.

8. The odor has gotten worse over time. It is now as bad as it's ever been.

9. We are on municipal water and have had our water tested. The tests say it is fine, but sometimes when you turn the water on, it turns brown. This did not happen before hog facility started operating.

10. I think I would have a problem selling my property if I wanted to, because of the hog houses.

Health Issues from Living Next to the Hog Facilities

11. My son [redacted] and I have health conditions that I believe might be connected to the hog facility. I have [redacted] problems, and my ear stops up. [redacted] has had [redacted] for five years. We did not have these health conditions before the hog facility was built.

Activism around Hog Farming

12. I joined the [redacted] organization. They try to work to get the hog houses fixed so we won't smell that odor. I have been involved with the [redacted] for seven years. [redacted] named me Mother of the Year in 2007 because of my service to my community.

13. If I could change the practices at the hog facilities, I would want them to get rid of the odor, clean up the lagoons, and stop spraying.

14. I believe that the hog facility issue is a civil rights issue because they're built closer to the Black neighborhoods in this county.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Pinkhill North Carolina on August 30, 2014.

Signed: [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

[redacted]

Exhibit 16

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted]n [redacted] (See Attached Map.) I have lived at this address for thirty-two years and I own my home. I live alone. I am fifty-nine years old.

3. I am a co-founder, [redacted]t the Rural Empowerment Association for Community Help (REACH) organization. The REACH office is located at [redacted]

4. REACH strives to improve the quality of life for families and people of color in rural eastern North Carolina. In particular, REACH addresses social, economic and environmental issues of families and people of color in Duplin, Sampson and Bladen counties in eastern North Carolina. REACH's programs include environmental awareness, sustainable agriculture, small business development, and homeownership, among other things.

5. My primary goals as [redacted] for REACH are to protect, educate and collaborate with the people that I serve.

REACH serves over 800 southeastern residents through its various programs. In my current role at REACH, among many other tasks, I act as a liaison between REACH and the surrounding community; build relationships between REACH and other non-profits, as well as county and state government; make presentations at local and regional meetings; plan meetings; and coordinate studies and testing relating to the effects of industrial hog farming on the surrounding community and environment. Those studies include testing for hog related MRSA (Methicillin-resistant Staphylococcus aureus) among hog farm workers and water sampling.

REACH's Efforts to Change Hog Farm Practices in North Carolina

6. In 2005, I submitted a grant proposal to U.S. EPA to address the impacts of CAFOs on people and the environment in southeastern North Carolina. The project title was Duplin Environmental Health Awareness Project (DEHAP). With this funding, myself and the then Executive Director of REACH, were able to have a listening session where we asked what people's concerns were and they shared their experiences with living near industrial hog farms in eastern North Carolina.

7. Under DEHAP, twelve individuals were selected to act as Advisors to REACH to be our environmental eyes and ears in the community. They act as concerned citizens with a strong sense of stewardship and caring for the water, earth and air. When the grant ended a year later, the group decided to continue with

or without funding. The group meets regularly with approximately 20-30 other grassroots community members.

8. Originally, DEHAP arose out of organizing that I did in collaboration with Steve Wing, a professor of epidemiology at the University of North Carolina in Chapel Hill. Before I started organizing, I knew it smelled bad where I lived, but I didn't know about other places. It was only until after I talked to people in different areas within Duplin County that I realized how bad it was for so many people. Residents were angry because of the stench that they endure, that is not caused by them. From my own observation, it appears that the hog growers don't care about how bad the smell and pollution from their farms effect their neighbors.

9. In 2006, REACH received an EPA Collaborative Problem Solving Grant to join together the grassroots community with businesses and government to address environmental problems. Under this grant, DEHAP constituents met with other stakeholders to discuss how industry has contributed to pollution in eastern North Carolina.

10. On April 10, 2007, REACH invited our membership to come along with the organization leadership to testify about the impacts of hog farms on the environmental and their personal well-being. The testimony was delivered at a convening of the National Commission on Industrial Animal Production in Durham, North Carolina. Five REACH members testified at the meeting. Other

EJ partners, including [redacted] from the North Carolina Environmental Justice Network, and [redacted] he then Lower Neuse Riverkeeper and now CAFO coordinator for the Waterkeeper Allicance testified as well regarding the effects of industrial hog farms on communities and the environment. The transcript of the hearing is accessible here: http://www.ncifap.org/_images/NC_Public_Meeting_Transcript_.pdf. Because of events like this and REACH's work investigating more about the issue, I know people who have suffered terribly living near industrial hog farms. I know about hog related MRSA (Livestock-Associated Methicillin and Multidrug Resistant Staphylococcus Aureus) and its impacts as well from a study I worked on. I'd like to see better use of available technology, like wastewater treatment plants, to clean up the wastewater associated with the hog farms. I am concerned about the cost to the environment from the industrial hog farms and the health of the people who live nearby.

11. I believe that additional work needs to take place to make significant systemic changes in how industrial farms operate and how they are regulated. DEHAP Advisors and other concerned citizens have agreed to continue to meet until the water, air and soil are cleaned up and are no longer affecting people's health. Right now, DEHAP meets monthly to discuss these issues and to reach out to the community.

12. REACH water sampling includes testing for markers that we think indicate diminished water quality in the watershed. Specifically, we have tested streams in the watershed for E. Coli., MRSA, fecal coliform and enterococcus. We informally submitted this data to the North Carolina Department of Environment and Natural Resources (DENR) to have one watershed in particular, Maple Branch, added to the 303(d) list. As of today, that water body has not been added to the state's list of impaired water bodies, and REACH plans to continue to advocate for its inclusion.

13. Through REACH, I have traveled extensively in neighboring communities and across the country, to New York, New Orleans, Denver, Washington, D.C., Los Angeles, Atlanta, and to meetings of the National Environmental Justice Advisory Council ("NEJAC") with other members of the community to voice our concerns regarding the negative impact of industrial hog farms in eastern North Carolina.

Personal Experience with Hog Facilities

14. Nearly everywhere I am, whether at home, or at the REACH office, the hog farms are around me.

15. The closest Concentrated Animal Feeding Operations (CAFO) to my home and my office are less than a [redacted] (b) (6) Privacy away.

16. My home and office at REACH are about a mile apart. There are at least 13 hog facilities within a two-mile radius of my home and the REACH office.

17. There are many industrial animal operations, including but not limited to hog houses, near the REACH office. There are five farms south of the office. From a two-mile radius west of the office, there are two hog farms. There are about four hog farms southeast of the office. Going east, up Wards Bridge Road, there are six hog farms. Northward, there are about five more. I know this because I have conducted tours, and because I was born and raised in the area.

18. We hold DEHAP meetings at the REACH office and we almost always hold the meetings inside because of the smell. If we serve food, we have to come inside because we don't want to eat food that smells as bad as the air.

19. I also know the area well because I have walked along the creeks, in the woods, and I've hunted and fished in the area. I have a few dogs and I also still hunt. I used to take pride in freshwater fishing and catching fish. A while ago I started to see fish with sores on them. I threw them back in the water. I believe these negative changes can be attributed to the industrial farms in the area.

20. In the past, before expansion of the industrial hog farms, my family had a lot of cookouts outside at my home. I am from a large family, and am the middle child of seven siblings. All of us live in Duplin County. I have several nieces and nephews. I even have a heavy duty picnic table because of all the

cookouts. Now, even with family reunions, we have to find a place indoors because of the flies and the stench. We also have visitors who can't tolerate the smell.

21. I have been on county water for about 15 years. I was on well water before that. I switched over to the county water when they were installing the lines because they local government offered a discounted rate on the meter. I paid the application fee and although I wasn't planning on using it, I knew it was there. One day my well-water pump wasn't working properly. It was easier to cut my line to the pump and get hooked up to the county water than to fix it. Even though I have a choice, I would not go back to using well water in Duplin County. There are so many CAFOs close by and so many lagoons in Duplin County, that I don't think it is a good idea to drink the water from the well. I believe that the lagoons leak into the aquifer. If the well is shallow — which I believe it is because when I drilled the well, I found that I could get water at 38 feet — I think that the hog waste pollution leakages would enter the aquifer and pollute my well.

22. The outreach I've done and the research I've read has made me more concerned about the negative health impacts that CAFOs bring to my community

23. It's my understanding that there are over 500 active hog farms in Duplin County. Out of these, very few are owned by Black people. There is nowhere in this part of the county that people can get away from the stench of a

CAFO. The bad smells also come from trucks that haul the hogs around. Sometimes there are trucks filled with dead hogs that pass by and the trucks smell even worse than the swine lagoons.

24. I strongly believe that anything that smells this bad cannot be healthy. If I drive to church, to a school, or to the store, the odor gets in my car. I don't have to be a lawyer to know that something is wrong with this picture. I have children and grandchildren, and I want for them to have a better life. I think it's a God-given right to have clean air and clean water. No one should be able to profit at the expense of their neighbor's health and well-being, which I believe is happening due to the poor regulation of industrial hog farms in eastern North Carolina.

25. It is my understanding that there are bacterial and other viral problems associated with CAFOs that my neighbors and I may be exposed to. There are also health issues from the super viruses that are created which need to be addressed.

26. Being raised in an agricultural county, and having seen other agricultural facilities operate, I know that there are drain tiles underneath the ground of the fields which, when combined with hog waste, also concern me. On any new ground that's been cleared, before they plant, drain tiles are installed to have excess water run downhill. This prevents the crops from drowning. If the farmer sprays hog waste on a field and there are subsurface drain tiles, the water

seeps through the ground to the drain tiles and into ditches. This water then runs into a bigger ditch and keeps running until it reaches a nearby creek or stream.

27. I think the hog industry is very influential in the local and state government. The permits are issued without enough questions and clarity from DENR. I don't think DENR analyzes the permits well enough. To be specific, hog lagoons should not be in a flood plain. In addition, using clay alone as a lining for the lagoons definitely allows leaching, as they do currently.

28. The smell and pollution from CAFOs are problems that DENR should better address.

29. Within the last year I have seen overrun dead hog boxes that attract buzzards.

30. I believe that the way that the state allows the hog facilities to operate is a civil rights issue because, as stated previously, of the over 500 farms that I know of, only two or three are owned by Blacks, but the location of the hog farms are all near Black communities. These hog farms are not near gated communities and golf courses. It is an injustice to people of color. I believe that communities of color have been targeted because the power structure assumes that communities of color won't pull together to address this issue. Because it is our land, I believe that the current laws are intentionally lax to support the industry.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Warsaw, North Carolina on August 30, 2014.

Signed [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 2 miles

Source: Google Maps

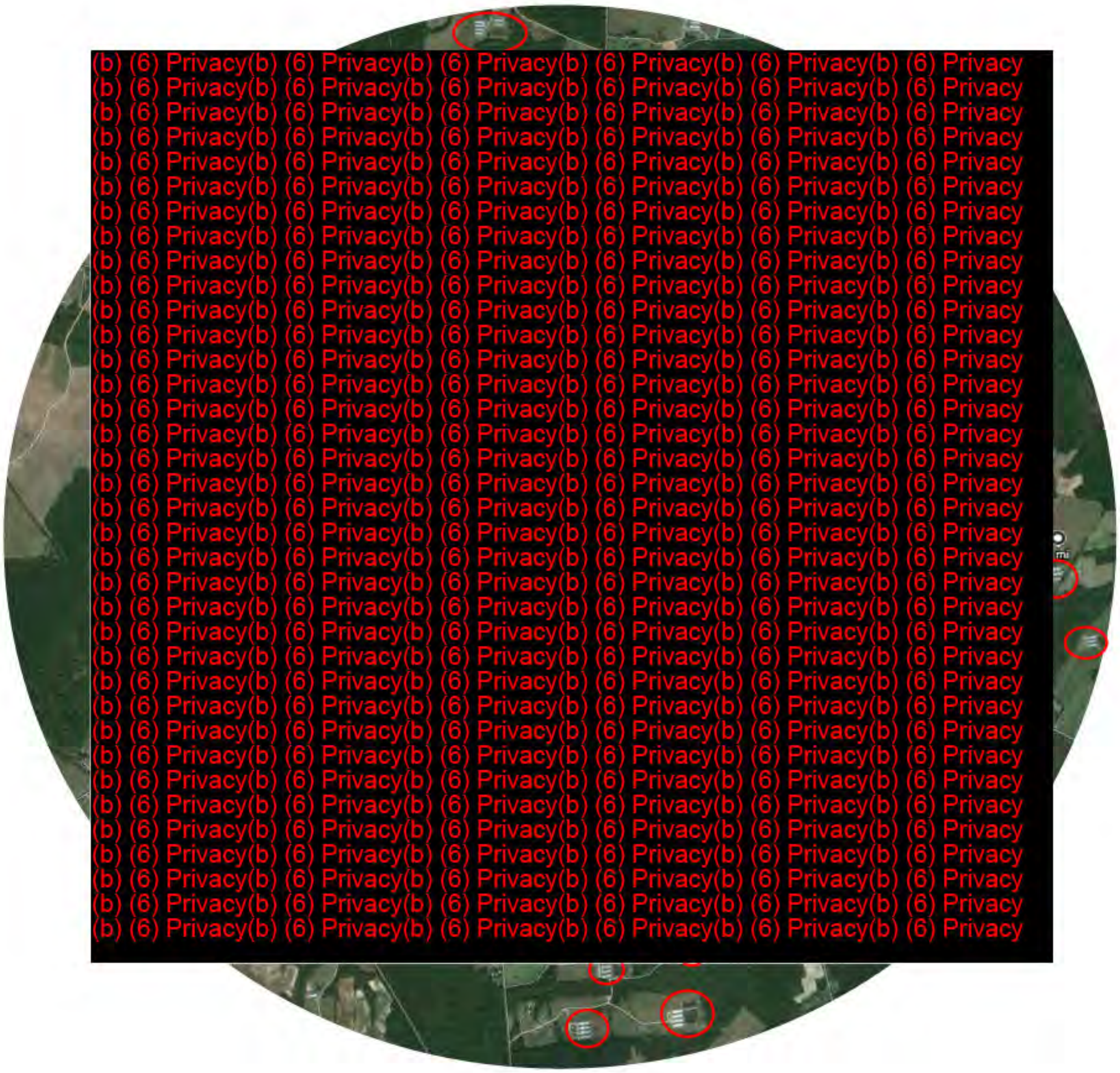

[redacted]

Exhibit 17

DECLARATION OF [redacted]

1. My name is [redacted]. I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African American. I live at [redacted] in [redacted]. My house is built on land that my family has owned since 1891. I was raised on this land with my family and have lived here for more than half of my life. After graduating high school, I moved to New York City to work in the banking industry and stayed for 27 years. I returned to Wallace in March of 1993 to care for my mother and have lived here ever since.

3. My family owns over 60 acres of land in [redacted]. My grandfather purchased one tract of land in 1891, and three tracts of land in 1897. Our land stretches from [redacted] to the north and [redacted] to the south, as shown in the map attached as Exhibit 1.

4. In the late 1980s, a hog facility was built next to our homes on land we believe is ours. As shown in the map attached as Exhibit 2, the hog facility is located between [redacted] and [redacted], off an unmarked road west of [redacted]. The hog facility consists of two hog houses, a manure storage lagoon, and sprayfields. The sprayfields are located a few feet south of

[redacted] the waste lagoon is south of the sprayfields, and the hog houses are south of the lagoon, near [redacted].

5. A few of my family's homes are close to the sprayfields.

6. My now-deceased mother's house is located a few yards east of the sprayfields. Her house is marked as number 2 on the map attached as Exhibit 3. My mother lived in the house with my now-deceased brother, [redacted] who had Down Syndrome and was not able to care for himself.

7. My house is a few feet north of my mother and sister's houses. My house is marked as number 1 on the map attached as Exhibit 3. My yard joins my mother's yard and my sister's yard. Although I own the house marked as number 1, I currently live in my mother's house. My niece, [redacted], lives in my house.

8. My now-deceased sister's house is a few feet east of my mother's home. My sister's house is marked as number 3 on the map attached as Exhibit 3. My sister's daughter, my niece, now lives in this house.

9. My nephew, [redacted] lives in a mobile home to the east of my house. His home is marked as number 4 on the map attached as Exhibit 3.

10. My nephew, [redacted], lives on the north side of [redacted], directly across from the sprayfields. His house is marked as number 5 on the map attached as Exhibit 3.

11. Given how close my family lives to the hog facility, and the sprayfields in particular, many members of my family, myself included, have been exposed to the odor and harmful pollutants that come with raising animals in confinement.

Experience Living Next to the Hog Facility: Early 1990s

12. The hog facility was built in 1986, but the farmer did not begin spraying waste on the sprayfields next to my mother's house until the mid-1990s. Before that time, he sprayed the waste farther away from our homes. In those early years, the farmer used a large sprayer that was hooked up to a tractor. It was difficult to control where the spray would land with this system. Back then, there were no trees separating our houses from the sprayfield. As a result, when the wind picked up, the manure, urine, and other waste that was being sprayed on the field was easily carried over to where my mother, sister, nephews, and I live.

13. I remember the first time we experienced the farmer spraying the waste. It was a Saturday, and I was with my mother, brother, and nephew Robert at my mother's house. We were sitting on my mother's screened-in porch, enjoying being outside as we had done for years. As we were sitting there, I noticed the farmer bring over the tractor with the sprayer hooked up, then disappear. Just as I was thinking to myself that there was no way that he would begin spraying so close to us, I heard a bursting sound. The sprayer had begun to

pump waste in our direction. We had to scramble to get out of the way. My mother, brother, and I took refuge in my mother's house, and [redacted] retreated to his house across [redacted] The waste had this terrible, raw, stinking odor that we had never before experienced. We could still smell it when we were inside. The spraying continued, and the waste was blown right onto the side of my mother's house. My mother's kitchen, my brother's room, and the bathroom all face the sprayfields. If the windows were open, the waste would have landed in the house.

14. My mother's house was not the only one inundated with the waste in those years. The waste also blew into the storm door near the front of my house. I had to keep my door closed otherwise the waste would get into my home. My sister and I couldn't hang our clothes out in our yards because when the farmer sprayed, we could feel the waste mist on the clotheslines.

15. In those years, I spoke to the hog farmer about my concerns about the foul smelling hog waste that he was spraying on the fields. I told him that the waste was blowing over to our property, landing in our yards, and pounding our homes. The farmer told me that the hog houses were his investment and that he had to spray to protect that investment. He seemed mad that I had approached him with our concerns.

16. Because the farmer did not do anything to stop the waste from blowing onto my family's property, I called the Sherriff's Department, who informed me that they could not get involved in the matter. They told me that the Health Department in Kenansville would handle my complaint. When I spoke with someone at the Health Department, I was informed that I would have to call the Department of Environment and Natural Resources ("DENR") in Wilmington, because they dealt with problems like mine. In total, I called or wrote letters, or both, to the Governor, the State and Local Health Department Directors, the Attorney General of the State of North Carolina, the United States Justice Department, DENR, the local Sherriff, the County Commissioners, the United States Environmental Protection Agency, and United States Representative Mike McIntyre's office.

17. I made so many complaints that the county lawyer, who also was working with the hog industry in Duplin County, wrote me a letter saying that if I continued to make what he called groundless complaints, particularly to DENR, that I could be made to serve time in jail or would have to pay the hog farmer the money he was losing because of my complaints.

18. The hog farmer and his son also threatened me and my family and tried to get us to stop making complaints. One time in the late 1990s, or early 2000s, the hog farmer came over waving a stick, warning me not to make what he

called baseless claims. His son came over twice with a gun. One Saturday, the hog famer's son entered my mother's house, uninvited, and shook the chair that my mother was sitting in and started cursing at her. He yelled that he could do anything to me that he wanted to and get away with it. At the time, my mother was [redacted] years old, so needless to say this was traumatic for her and my family.

19. In my attempt to stop the hog farmer from spraying waste on me and my family, I collected evidence of the spraying. One day, when the farmer was spraying, I stood in front of my house, near where my yard and my mother's yard meet, and began to videotape the spraying. As I was taking the video, the hog waste being sprayed on the fields hit me in the face, landing on my lip. I was immediately concerned about the bacteria and chemicals in the waste, so I ran inside and scrubbed it off.

20. The farmer has made changes that are supposed to allow us to co-exist. In the late 1990s the hog farmer started using a stationary sprayer, with a pivoting head, instead of the tractor sprayer. The stationary sprayer is supposed to control the flow of waste better. In 1999 or 2000, at the urging of my local government representative, Carrol's Foods, which supplied animals to the farmer, planted trees between my family's houses and the sprayfield. Later, in April 2002, the hog farmer had a v ditch dug to separate what he believed is the property line, to settle a dispute about whether I had been trespassing on land that he claimed was

his. The changes are supposed to make it easier for us to live peacefully next to the hog facility, but my family and I are still suffering.

Experience Living Next to a Hog Facility: 2003 to present

21. I was told that the stationary sprayer would prevent the waste from coming on to our land, but the spray still reaches my family's homes to this day. At times, [redacted] is wet with waste from the sprayer. Cars driving by the sprayfield and my house have to be careful to keep their windows closed to keep the waste out. When the wind picks up, the waste can blow across [redacted] into my nephew [redacted] yard.

22. The trees also do not keep the waste from coming on to our property. The wind still carries the waste to our homes, and I still smell the terrible, raw odor of the waste. In fact, in recent years, the trees have been dying, and I can see right through to the sprayfields.

23. Even with the stationary sprayer and the trees, my family and I are still exposed to harmful pollution. People in the health field continue to warn me not to open the windows when the farmer is spraying, especially when I am cooking. Scientists at the University of North Carolina, including Dr. Steve Wing, and at Johns Hopkins University, including Dr. Chis Heaney, have cautioned me that particles that are too small for me to see or feel can travel through the tree line, and make me sick.

24. It's challenging just living near a hog facility. When the farmer is spraying, I try to stay indoors as much as I can, but sometimes I need to leave my house and run errands and live my life. If I have to go to my car when the farmer is spraying, I will hold my breath, cover my mouth with a perfumed mask or perfumed paper towel, and run to my car as fast as I can.

25. I can't stay outside for very long when the farmer is spraying. I get [redacted] have trouble [redacted], and get depressed that no one is trying to understand what we are dealing with, living next to a hog facility that sprays waste on us. Clean air is a God given right, but it's a right that my family and I are being denied.

26. I know that pollution from a hog facility can cause [redacted] and [redacted] problems, and am lucky that I have not yet suffered from these problems. I try to take precautions to make sure that I stay healthy, and counteract any of the effects of living so close to the hog facility. I avoid spending any time outside when the farmer is spraying, and make sure to keep my windows and doors tightly closed. I also eat right and exercise.

27. Although I like to exercise and stay active, I have to adjust my exercise schedule to account for spraying at the hog facility. I enjoy taking long walks or biking, often with my nephew, [redacted], who lives across the street. If the farmer is spraying when we want to go for a walk or a bike ride, we will change

our route, making sure to walk or bike in the opposite direction of the sprayfield and the wind that could carry the spray towards us. We also make sure to wear a mask to protect us from the spray. Sometimes we will set out on a bike ride or for a walk when the farmer is not spraying, but, by the time we return, he might be. We plan for those occasions, always making sure to bring along something to cover our faces, like a perfumed mask or a perfumed paper towel, so that if the farmer is spraying when we get back, we will be protected.

28. Living next to a hog facility also has affected my family's health and quality of life. My mother lived on the land from the time she was born in [redacted] until she passed away in [redacted]. My brother, [redacted], lived on this land from the time he was born until he passed away in [redacted] When the spraying began in the 1990s, both my brother's and mother's lives changed for the worst. Both my mother, who was advanced in age, and my brother, who had [redacted] and was [redacted] with [redacted], had trouble getting around and often stayed in or near the house. Although we had window air conditioners, they enjoyed sitting outside in the summer when there was a breeze. But when the hog facility moved in, it was not safe to be outside. In the early years, the waste from the sprayers hit the house and could have hit us if we were outside. Even after the farmer changed his sprayers, it was not safe to sit outside and breathe in the pollution from the facility. This is especially true for my brother, who breathed through his mouth, and could have

gotten sick if he inhaled the airborne pollution. So, after the hog facility moved in, to avoid the terrible smell and dangerous pollution, my family was forced to stay inside in the summer and spend the extra money to run our window air conditioners.

29. Since the hog facility moved next door, my family and I have been concerned about our water supply. We used to get our water from a shallow well on our property, but we knew the hog waste was blowing over the well and could be contaminating our water. When we finally had the opportunity to connect to the County's water supply, we immediately signed up. Because we signed up early, we only had to pay $50 for the connection. But now instead of using the well for our water supply we have to pay a monthly water bill.

30. My family used to be able to live off this land. We would hunt on the land, and fish in Rockfish Creek. Since the hog facility moved in, our way of life has changed. We lost access to a lot of our land, which we are fighting to regain. For right now, given that the farmer has taken over a lot of our land, we don't have access to the Rockfish Creek anymore, and we can't get to the land where we used to go hunt. Putting aside issues of access, even when we see animals, like deer, we are concerned about the contaminants that they might have been exposed to, and if they are safe to eat. Since the hog facility moved in, I also have noticed that there are fewer squirrels and rabbits than when I lived here as a child. I am not sure if

the animals are dying because of the pollution from the hog facility, but I do know that the environment has changed.

My Efforts to Change Hog Farming Practices in North Carolina

31. Given all of the problems my family and I have experienced living next to a hog facility, I have long worked with others, including the North Carolina Environmental Justice Network ("NCEJN") and the Association for a Responsible Swine Industry ("ARSI"), to change the way hog farms are allowed to operate. I started working with NCEJN around 2000 or 2001. I have worked with ARSI since the late 1990s, around the time when North Carolina enacted the moratorium against constructing or expanding hog farms of a certain size.

32. With NCEJN and ARSI, I have lobbied the Capitol and asked our legislators to control the toxic pollution from the hog farms. On one trip in June 2007, we camped out on the lawn in front of the Capitol and kept vigil. We brought along a mock hog facility, complete with a mini lagoon holding actual swine waste and a sprayfield. The elected officials began avoiding us on the lawn, noting the terrible smell. One security officer even threatened to have us removed for bringing the swine waste, which he claimed was "toxic material." He even told us that if we spilled any of the waste, we would be fined $1,000. I want everyone to recognize that hog farms are spewing toxic material on me and my family and others who live next to hog farms.

33. I know that there's a better way to raise livestock and dispose of the waste than simply digging a hole in the ground. As far back as the early 2000s, the Smithfield Study came up with five alternatives to the lagoon and sprayfield system, but the industry complained about the cost. Those of us living near these facilities need the industry to adopt better waste controls. The industry cannot be allowed to continue to dump toxic material into our air and water.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Wallace, North Carolina on April 18, 2014

[redacted]

EXHIBIT 1

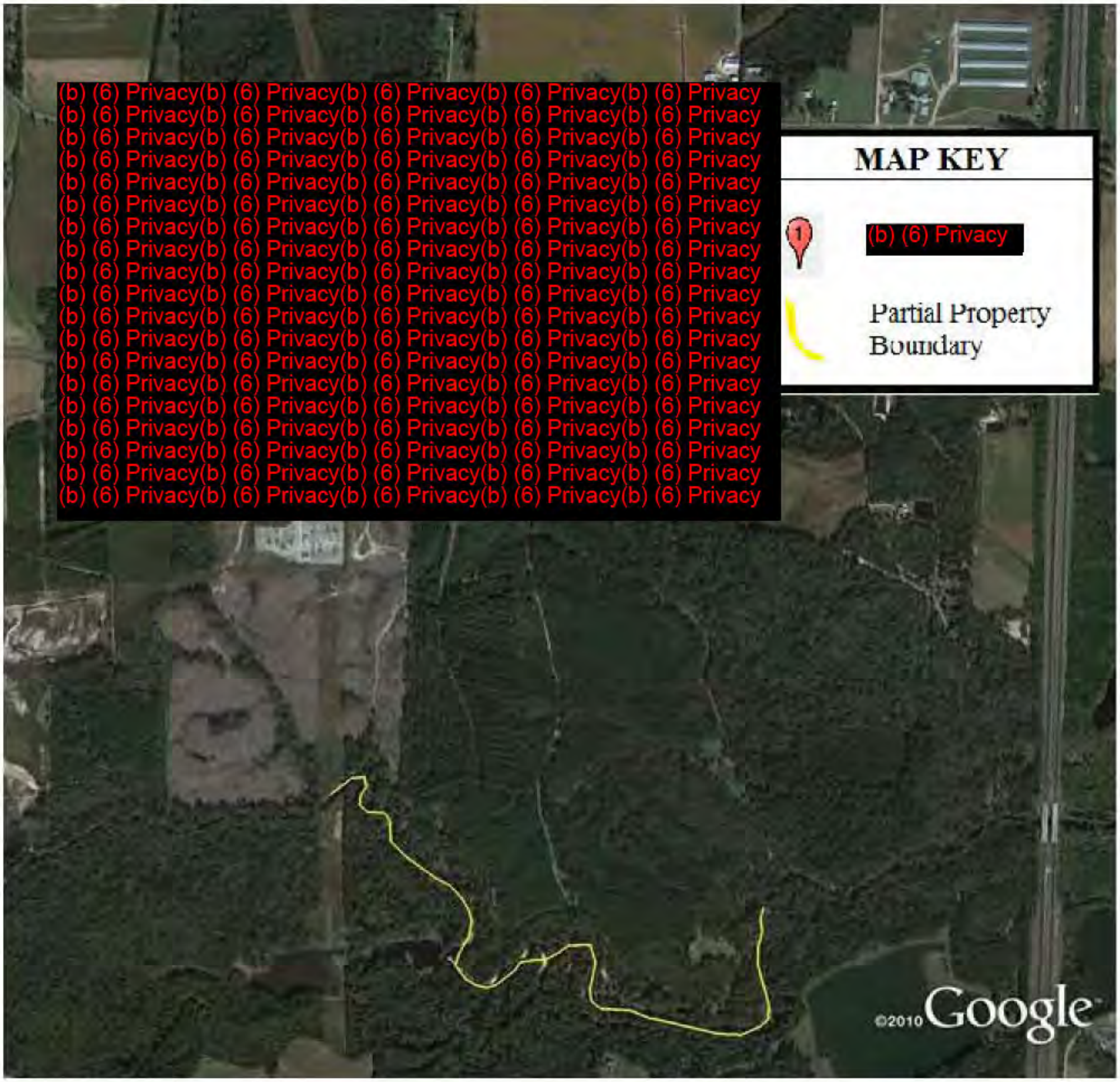
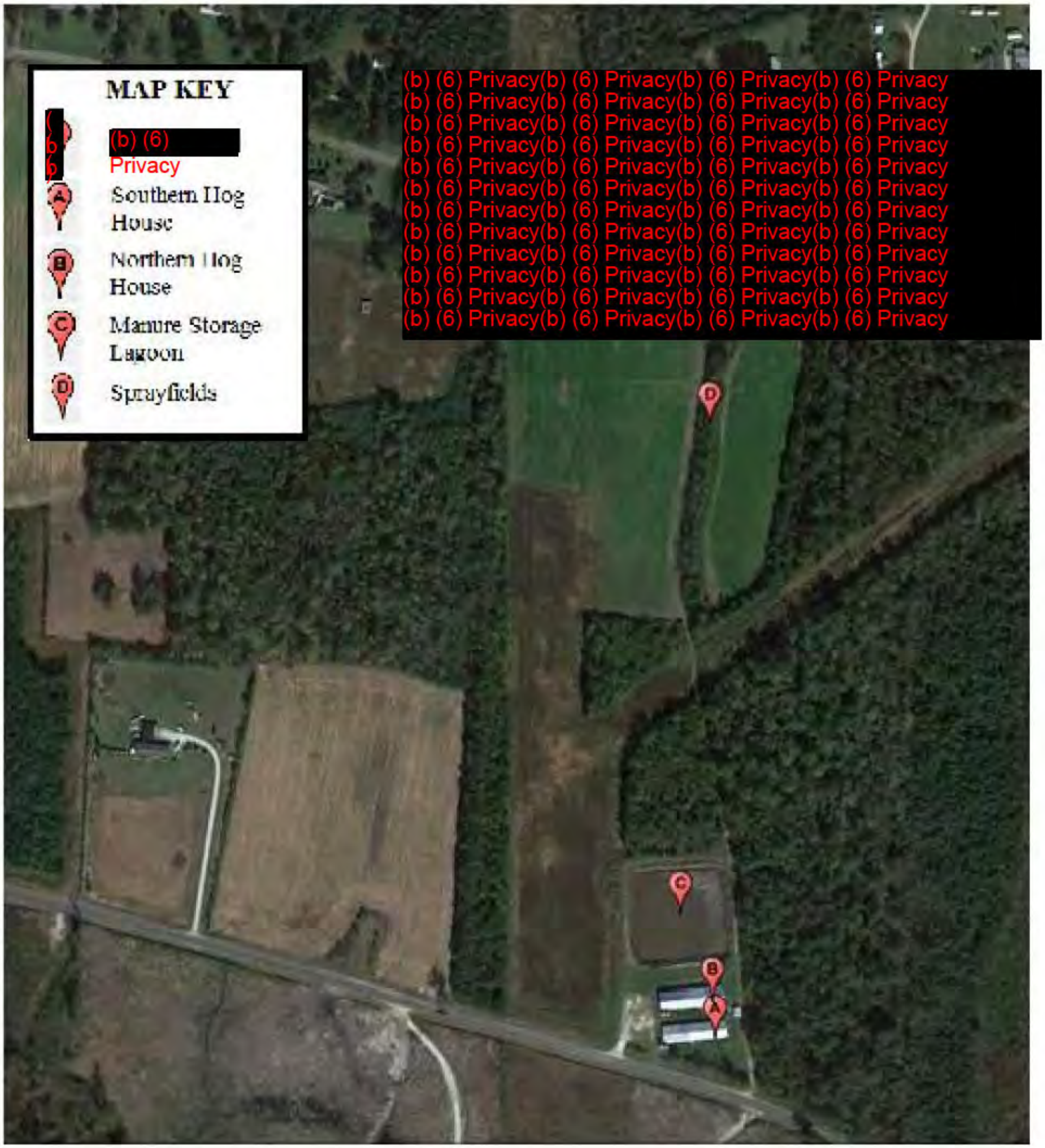

[redacted]
MAP KEY
[redacted]
Partial Property Boundary
©2010 Google

EXHIBIT 2



MAP KEY
[redacted]
Southern Hog House
Northern Hog House
Manure Storage Lagoon
Sprayfields
[redacted]

EXHIBIT 3

NOTE: Hog Facility extent drawn from tax parcel information found on Duplin County Tax Administration's website and may not be 100% accurate

Exhibit 18

DECLARATION OF [redacted]

1. My name is [redacted] am of legal age and competent to give this declaration. All of the information herein is based on my personal knowledge unless otherwise indicated.

Background

2. I am over [redacted] I live in the Rocky Point, North Carolina area. I am African-American.

3. I am a 1991 graduate of John Jay College of Criminal Justice in New York City. After graduating, I served as a Peace Officer at the City College of New York, and I ultimately achieved the rank of Lieutenant before retiring from law enforcement. I also worked as a claims investigator for Blue Cross Blue Shield, I operated a restaurant in Harlem, and I managed housing developments for J&K entrepreneurs in New York City before I moved to North Carolina in 2004.

4. I am a full-time [redacted] which is located at [redacted]. I serve a congregation which seats 125 people, about half of whom are on the Church role and from Rocky Point and several of whom commute to the church from other communities.

Experience as a Minister for a Church Located Near Hog Facilities

5. There are five hog facilities within a two mile radius of my church, as well as several large chicken farms.

6. I first learned about CAFOs (Concentrated Animal Feeding Operations) in October 2004, when I came down to visit my new congregation just two weeks before I became pastor. As I was touring the community and introducing myself, I remember asking, "My God,

what is that smell?" I was told, "Oh, it's those pigs." I recall being amazed that people could live with such an awful smell.

7. The smell from the hog CAFOs changes depending on the wind and weather. Sometimes I cannot smell it, but in hot, humid, moist weather the stench is inescapable.

8. I personally pass by hog CAFOs several times a week on the way to church for services and Pastor study sessions. Sometimes smell from the CAFOs gets in my car and stays there.

9. I regularly experience symptoms such as [redacted] My doctor has told me that allergies may be to blame, and I wonder if pollution from CAFOs contributes to my symptoms. Sometimes the smell is so strong it makes me feel like I am going to regurgitate.

10. Being near so many hog CAFOs seriously interferes with activities at my church. One of the most important events of the year at my church is our Good Friday fish fry, during which we use outdoor grills. The smell from the CAFOs often forces us to move the fry inside, but doing this leads to the church smelling like fish.

11. In general, the stench from the CAFOs prevents my congregation from enjoying the outdoors and keeps church activities confined inside. We have had to cut back on activities such as picnics, car washes, and carnivals with slides and animals for the children.

12. As a [redacted] I hear about the ways in which hog CAFOs affect the lives of people in my congregation. The smell often interferes with their daily lives and enjoyment of their property. Some feel under pressure not to speak out. One member of my congregation is asthmatic and is frequently hospitalized for his condition. Although the cause is not known, I wonder if pollution from CAFOs triggers his symptoms.

13. In 2006, there was a period when the smell from CAFOs was so bad—as if something had died in the church. On Wednesday, August 6, 2006, I tried contacting the Pender County Health Department to report it. My phone calls were not returned. I have not contacted other state or county authorities regarding CAFOs since then because I was under the impression that they could not or would not do anything about the problem.

14. I wonder why CAFOs are all located in areas where African-Americans, Mexican-Americans, and lower-income families live, and why there are no CAFOs in more wealthy, Caucasian areas. I think the location of CAFOS and the way they affect nearby communities such as my congregation is a civil rights issue.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Pender County, North Carolina on August, 29th, 2014

[redacted]

EXHIBIT 1

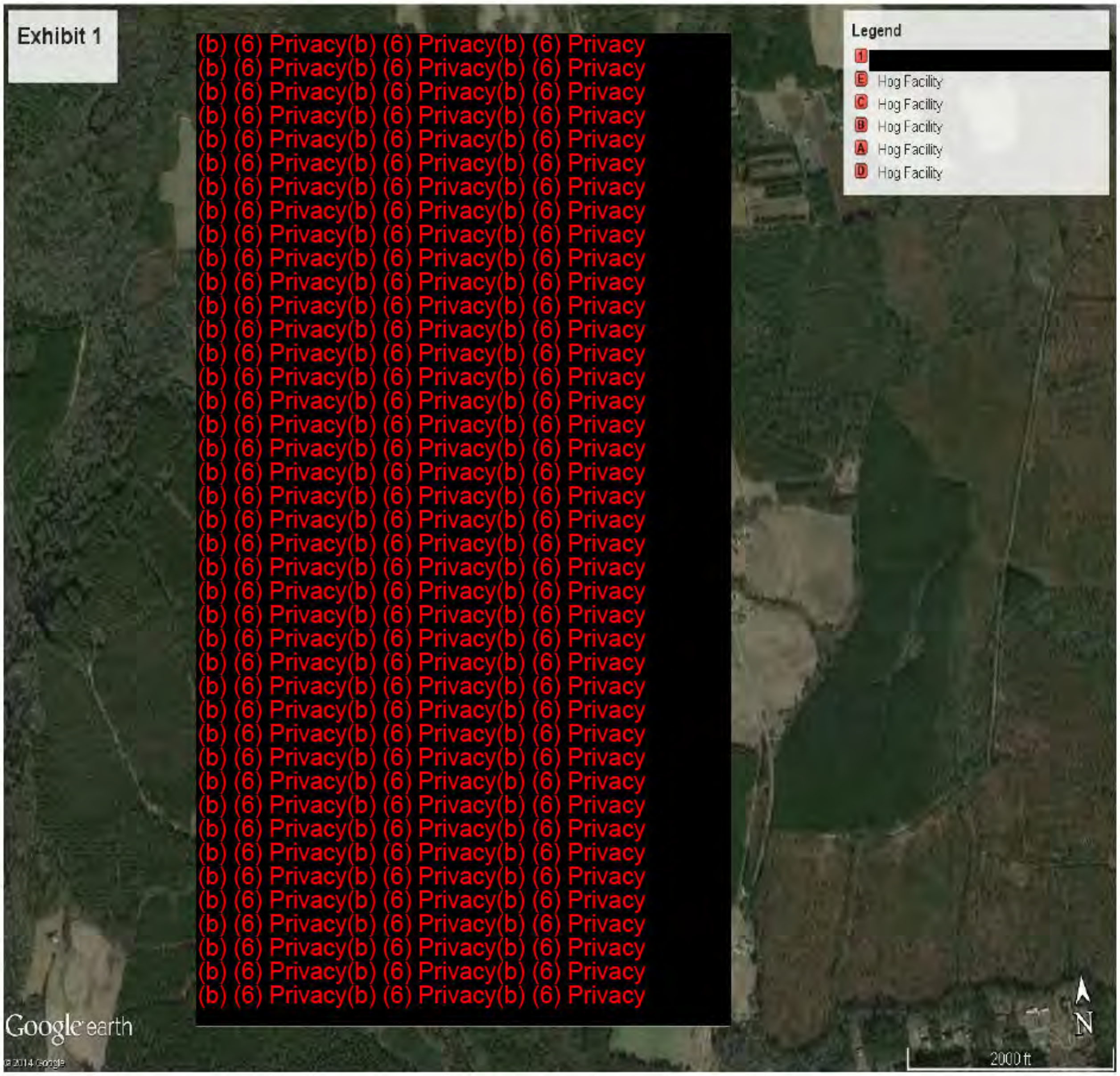


Exhibit 1
[redacted]
Legend
[redacted]
E Hog Facility
C Hog Facility
B Hog Facility
A Hog Facility
D Hog Facility
Google earth
2000 ft
N

Exhibit 19

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information in this declaration is based on my own personal knowledge unless otherwise indicated.

<u>Background</u>

2. I am African-American. I am [redacted] I live in a home I bought thirty years ago, at [redacted] (See Attached Map). I also lived at [redacted] The closest hog farm from my current location is less than half a mile away.

3. I used to be a CNA (Certified Nursing Assistant) at Guardian Care. I worked there for twenty-five years. I retired in 2000 because I became sick and I couldn't go back. If I had not become sick, I would have continued working for a few more years. I retired due to emphysema.

4. I have never worked at a hog farm and no one in my household has ever worked in a hog farm.

<u>Experience Living Next to a Hog Facility</u>

5. I believe that living near a hog farm negatively affects the value of my home. It also affects my ability to enjoy my home because my family and I can't

sit out on the porch when the hog farmers spray. I would sit out on the porch all the time if it wasn't for the spraying.

6. Because I have [redacted] I use an oxygen tank that I take with me everywhere I go, most of the time. I believe that my condition is related to living near the hog farm. Without my oxygen, it's hard to breathe because of the smell from the hog farms and the spraying. The last time I didn't have to use it was last week. If I didn't have it on, I would have a very hard time breathing. Even with my oxygen on, I can still smell the bad air from spraying when the wind blows and the smell is strong.

7. My wife had [redacted] few years ago. She also has Alzheimer's disease.

8. I have a stepdaughter who lives out here and she comes to visit me sometimes. She has a thirteen year old and a three year old. I sometimes have other visitors too. They like to spend time outside, but their time outside is limited by the smells from the hog farms.

9. I used to fish a lot from the bridge crossing the Sarecta River. I used to catch the fish and fillet them. The hog farms have taken away my enjoyment of fishing. When I used to go fishing, hog farms weren't like they are now. It was different back then. This was about twenty-two years ago, when my father lived here.

10. I used to hang my laundry outside to dry. I don't hang my laundry outside anymore because the smell would get on my clothes.

11. We currently use well water. I would like to switch to city water, but I can't afford it right now.

Advocacy to Remedy the Hog Farm Problem

12. I have never tried to join together with others to figure out how to fix the problem with the hog farms. If they were to do anything to fix the problem, I wish they would reduce the smell.

13. I feel that the hog farms are located primarily in African-American communities and this is an important civil rights issue. I would like to see EPA's Civil Rights Office investigate whether the hog farms have more impacts on Black people so something can be done about this issue.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Pink Hill, North Carolina on August 30, 2014

Signe[redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

[redacted]

Exhibit 20

DECLARACTION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted] n the town of [redacted] (See Attached Map). I bought my house in 1976. I am [redacted]

3. I am retired from the military and barbering. Currently I work only two days a week, part-time, as a barber. I also work some at Camp Lejeune and as a farmer.

4. I started coming to meetings at the [redacted] last year in October.

5. The closest hog farms from my home are right across the woods. The community is referred to as "Rainbow" after the local church. It's a black community. There is a hog farm close to the church. It's closer to the church than to my house. I have gone to that church since I was a young boy attending Sunday school. The house I grew up in is right next door to it.

6. My dad and granddaddy raised hogs on the ground. They raised hogs when the hog system was changing; this was in the 1980s or early 1990s. I

remember when my dad got rid of his hogs because things were changing and the big farmer was taking over the business.

7. The smell living near the big hog farms is awful now, not like it was back when hogs were raised on the ground. Now the smell is really bad and even worse when it rains. The wind can also blow the waste spray to your home. When this happens, you can't avoid the smell, especially if you are outside.

8. I spend a lot of time outside in the field trying to grow organic produce on my farm. Sometimes living near the hogs farms affects whether I want to be outside if the odor is really bad.

9. Ms. [redacted] was a retired school teacher who passed away soon after a hog farm moved close to her home. She attributed her decline in health to the hog farm. That was in the 1990s. She always talked about that hog farm, but at that time, people weren't really saying anything. She believed that it was the reason why she became ill. I'm worried more people might get sick from the farms.

10. I am on well water, but I don't drink the well water because it comes from under the ground where the lagoon waste goes. I have to buy my drinking water and I drink about a gallon of water a day, so I spend about five or ten dollars a week on water.

11. I like to hunt. I hunt mostly squirrels and deer. Animals still visit my property. I don't fish like I used to around here. I think the rivers and streams near here are polluted with hog waste, so I go to the ocean to fish.

12. My cousins live close to the REACH office, near Ralph Beech's Mill. When I go over there, I notice that the smell is really bad and the field where they spray is right in front of their house. It's the urine from the hogs that smells really rough.

13. I am not sure what they should do about changing the problems that arise from the hog farms. They need to fix it so that the odor decreases. They should do that here so we don't have to smell it all the time.

14. The people in Clinton that work at the rendering plant live near it and they have to smell that horrible smell every day too.

15. I think Black and Latino people experience more of the harm than anyone else from hog farms because we have the farms in our neighborhoods.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Warsaw, North Carolina on August 28, 2014

Signed: [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 1 mile

Source: Google Maps

[redacted]

Exhibit 21

DECLARATION OF [redacted]

1. My name is [redacted]. I am of legal age and competent to give this declaration. All of the information herein is based on my personal knowledge unless otherwise indicated.

Background

2. I am an [redacted] African American woman.

3. I live at [redacted]. I live with my mother, who is 48 years old, and my dog.

Experience Living Near Hog Facilities

4. My house is near a few hog facilities. Maps showing my house and the surrounding hog facilities are attached as Exhibits 1 to 3.

5. For me, the worst part about living near the hog facilities is how it affects our water. We are on well water. Ever since I can remember, there has been a problem with our water. I always knew something was wrong with the water, but I never really knew what was causing it. Then one day, my ex-boyfrend was over and he asked me if I thought we had issues with the water because we are so close to the hog facilities. That's when it dawned on me that the hog facilities were causing the problem.

6. We use a Pur water filter to try to clean our water. We got the pitcher at a thrift store and we replace the filters every month. Even though we filter the water, we still have problems. Recently, I was out for a run. I put regular water in a Powerade bottle and left for my run. When I went to take a sip of my water, I noticed that it was fizzing. I don't know what was in the water that caused it to fizz.

7. I can tell when the hog facilities near me have been spraying because it affects my water. The hog facilities near me like to spray at night. If I get up in the middle of the night to get ice from the tray, I notice it in the water. My ice will have an eggy smell to it.

8. Our water is often broken. My uncle comes by to fix the water, but it's never really fixed. It will shut off and when it's back on, it spurts out brown. I don't know what's in the water, but it might be related to all of the hog facilities.

9. I am used to the smell from the hog facilities, but sometimes I will invite people over who aren't from around here, like my ex-boyfriend who was from Nigeria or family from out of town, and they notice the smell and ask me about it. The smell embarrasses me, but I try not to let it bother me.

10. The hog facilities also attract really big bugs. There are huge flies and beetles near my house.

11. I recently was diagnosed with (b) (6) Privacy [redacted]. One day in June of this year, I couldn't walk or talk. Something was happening inside me. The doctors don't know what caused it. They kept me in the hospital for a few days, but then they released me. They didn't give me any medicine. Every morning when I wake up I have to think really hard so that I don't have a stutter. I am not sure if the problems with my water contributed to my conversion disorder.

12. My mom has bad (b) (6) Privacy [redacted]. She's scratchy all of the time, especially her eyes. I am not sure if her (b) (6) Privacy [redacted] are worse because of the hog facilities, but they could be.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Sampson, North Carolina on 8/28/14, 2014

[redacted]

EXHIBIT 1

EXHIBIT 2

[redacted]

EXHIBIT 3

[redacted]

NOTE: Map shows locations of swine facilities operating under the General Permit, as indicated in NCDENR's spreadsheet of permitted animal facilities, updated January 10, 2014. Circle shows permitted swine facilities within a 3 mile radius of [redacted] home, as calculated by Google Earth Pro.

Exhibit 22

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information in this declaration is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted]n the town of [redacted] (See Attached Map). I live there with my wife, [redacted] We have lived here for the past three years. Before living here, we lived in New York.

3. There is one hog farm with three hog houses about a mile away from my house and there is another hog farm on the opposite side of the highway that sits back off the road about a mile away from my house. There are other hog farms in the vicinity, but I can't pinpoint them because most of them are in a secluded wooded area.

Experience Living Next to the Hog Facility

4. Our biggest problem health-wise relates to how the farms transport the animals. [redacted]s the main highway and they haul chickens and hogs in trucks during the day. When a truck travels by, I see the truck, and then a couple of seconds later, we get the smell. Then there is the problem with the dust that is

stirred up and the unknown chemicals blowing in the wind which are invisible. I know we are breathing in some of that residue.

5. I don't open windows in my house because I am in such close proximity to the highway. When the dust blows, I always know that hog and chicken fumes are in the air. We have white vinyl siding on our house and we can see the hog waste residue settling on the side.

6. I recently contracted [redacted] I've had it before, but never as severe as this recent attack. The doctor's told me that I have a touch of [redacted] I'm taking two types of [redacted] and I'm using [redacted]. Because I live by the highway, I am consistently bombarded with trucks hauling hogs, and the smell and dust as a result. I think that the smell and dust from the highway contribute to the severity of my illness.

7. I feel that if I were to try to sell my house to someone coming in from outside of this location, they would take the proximity to hog farms under consideration. Anyone coming into Duplin County wanting to buy doesn't want to spend a lot on property, but because we have these odors and the air quality is so poor, people are likely to be reluctant to buy homes here. The current value of my home would be less than the same type of home in another area, and it would be because of the hog and chicken farms, and all of the problems that they cause.

8. I experience the negative effects of hog farms on my way to church in Clinton, North Carolina, which is in the city limits. I have seen the spraying in the spray fields. It's supposed to be treated waste from the lagoons. They usually spray in the evenings and I can really tell around 7pm or 8pm that the whole surrounding area is inundated with this repulsive smell. In a couple of hours, it dissipates. Being human, your mind and senses adjust.

9. It is my understanding from news reports that North Carolina is the second largest hog farming state in the Union, and Duplin County is a low wealth county and people take the attitude that nothing is going to do any good because little people don't have a chance.

10. My wife is a "go-getter" who strongly advocates about changing how hog facilities affect people. While I am not a go-getter like my wife, I would get involved in any advocacy that is going to better living conditions near hog farms.

11. If I could do anything to change conditions, I would limit the amount of hog farms in Duplin County. Fines are not enough—they must reduce the number. They built more hog farms in the woods. State regulators are not doing their jobs, because the numbers should be reduced. The hog farms should be spread out all over the state instead of just being in one low-wealth county. I'd really like to see that changed.

12. The system of transporting hogs to markets, or wherever they go, could be rerouted so the dust doesn't blow on the same people over and over again.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Warsaw, North Carolina on August 30, 2014

Signed: [redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 2 miles

Source: Google Maps

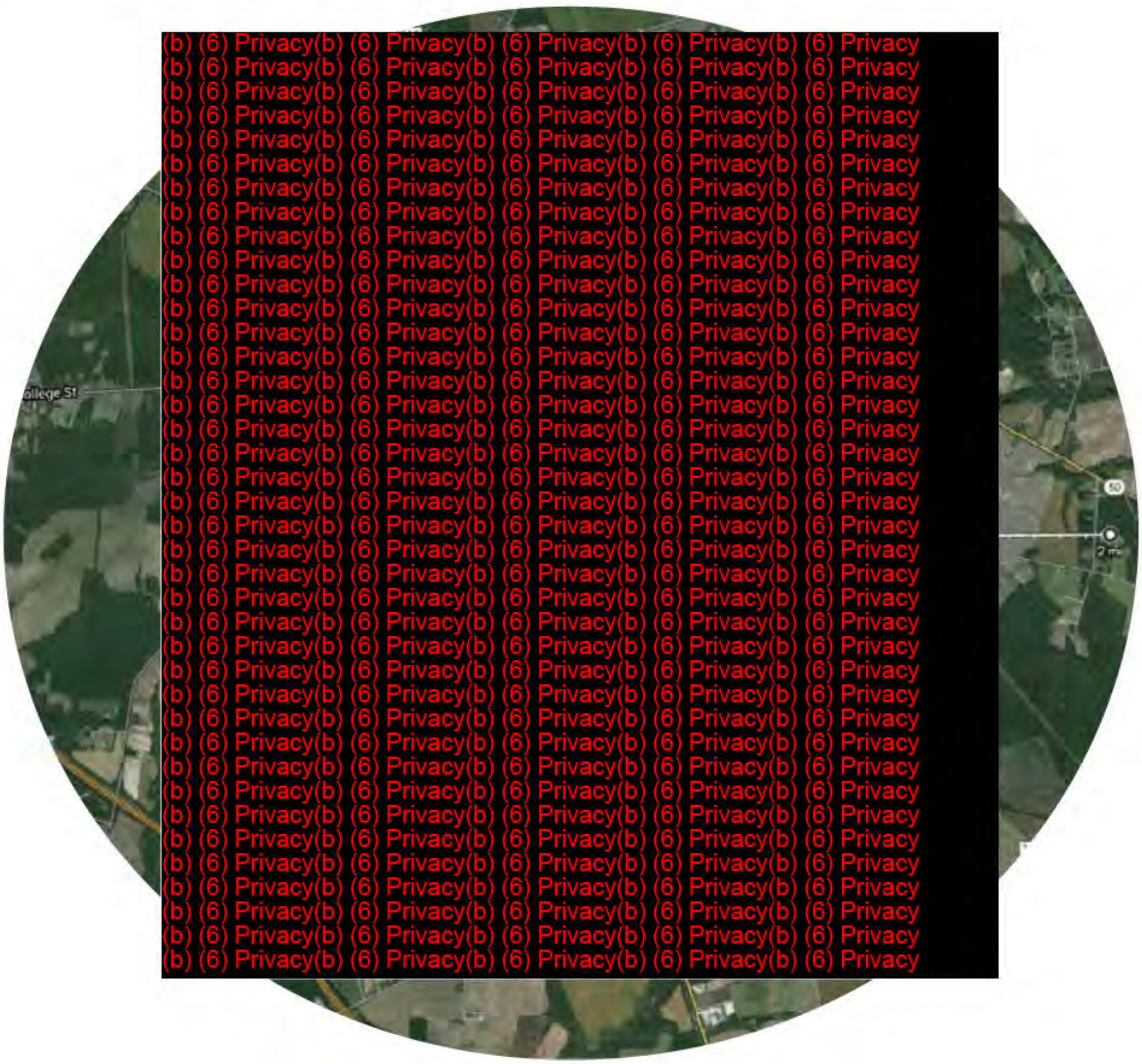

[redacted]

Exhibit 23

DECLARATION OF [redacted]

1. My name is [redacted] I am of legal age and competent to give this declaration. All of the information herein is based on my own personal knowledge unless otherwise indicated.

Background

2. I am African-American. I live at [redacted] in the town of [redacted] (See Attached Map). I live there with my husband, [redacted] I am [redacted]

3. I am originally from Duplin County. I left in [redacted] when I graduated from high school. I went to Philadelphia and lived in Brooklyn and Long Island before returning to North Carolina full time to be with my family.

4. For about five years, my husband and I have been running a convenience store in Warsaw. The convenience store is located right next to our house. In 2007, I bought the house that we're currently living in. I bought it because I wanted to rent or buy the convenience store.

5. The closest hog farm from my house, and our convenience store, is less than two miles away. The next closest one is in the same radius; it seems like it's not quite two miles away. Because we live and work so close to the hog facilities, we are always exposed to the smell and the pollutants from the farms.

6. Hog farms didn't always used to be so bad. Back before I moved away, there were farmers raising hogs in the natural way.

7. I have a theory about why the mass production hog farms came to Duplin County. As Duplin County is a poor county, with high unemployment, they decided to settle here where there were a lot of uneducated people who got suckered in. People started losing their farms in the late 1960s and early 1970s. Savings banks were going belly up. In areas where people used savings banks instead of banks like Citibank, people got suckered into the debt to build their houses. The county has been in bad shape ever since.

8. In 2007 I rode in my friend's small plane to see the area. Once we were in the air, I saw that there were a lot of hog farms in the woods.

9. The current hog farms are larger than when they were first built, due to expanding over the years.

Experience Living and Working Next to the Hog Facility

10. I moved here two years before my husband because my father passed away. My husband came in 2009, two years after I arrived. After living here for two and a half years, he developed a [redacted] from the pollution in the air.

11. I don't open the windows at my house for two reasons. The first reason is because I smell the odor from the hogs on the trucks that are being taken to or from the hog houses.

12. The second reason I don't open my windows is because of the gas fumes from the sitting, idling trucks. The trucks come down [redacted] Some trucks carry live hogs and others haul the dead hogs to other places. No matter when they come, they always stop at the crossroad near my home. I estimate that about ten trucks come through here every day with hogs. Traffic makes them idle and leads to more fumes. After the trucks pass, by you can see hog waste on the ground. You can always tell when one of the hog trucks goes by because of the smell.

13. We have been connected to county water since I moved back. We got on county water because I think that the runoff from the hog lagoons will get into the well water since we have a high water table.

14. In Long Island, New York, I used clothes lines to dry my clothes. When I moved back to North Carolina, I wanted to continue to dry my clothes outside in the summer. But now I have a dryer for both convenience and to avoid going outside because of the hog smell.

15. My husband likes to barbeque in the evenings. My back porch would be nice to use because it's screened in, but I don't use it anymore because of the bad air. In the evening, you know that you are in the vicinity of a hog farm when the wind changes direction.

The Impact of the Hog Facilities on Our Health

16. My husband will be [redacted] his year. He has a nurse practitioner who helps him with his health conditions, including his [redacted] issues. The nurse practitioner knows about my husband's issues with hog farms.

17. We have air purifiers in our house, one in the front and one in the bedroom, to keep the air pure. We purchased the air purifiers to help my husband get over his coughing, which occurred at night. Since we bought the air purifiers, his coughing has improved. His [redacted] started within the last two months. He never had problems breathing before, even when we had dogs. This has been a change with him, and I think our working and living near the hog facilities has made things worse. My husband has a machine with a long pipe in it that helps him breath. He also has an inhaler.

18. I have also developed a persistent cough, which I never had before moving back to North Carolina. The doctors can't find what's causing my cough. I think my persistent cough has something to do with the hog farms.

Changing the Way We Produce Hogs

19. Since I moved back to Warsaw, I have been advocating with a community group, Rural Empowerment Association for Community Help (REACH) against allowing these massive hog farms to negatively affect community health and welfare.

20. My sisters also worked with REACH to change the industrial hog system. They help REACH with the testing and surveying the environment to figure out how the hog farms affect people and the environment – for instance, they'd get up at a certain time in the morning to take measurements of the air quality.

21. We don't need mass production of hogs. We should create more jobs, not more hog farms. The way they used to raise the hogs back in the day was better. Now people want to do mass production.

22. These hog farms infringe on our rights to have a decent place to live without pollution. I do think there is more of a negative effect on African-Americans.

23. I know there is always a better way for humankind to live. If you would look at a map of where all the hog farms are in Duplin County, the hog farms would appear like a thumbprint over the whole county.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Warsaw, North Carolina on August 30th, 2014

S[redacted]

Address: [redacted]

Addressee: [redacted]

Map radius: Approximately 2 miles

Source: Google Maps

Exhibit 24

DECLARATION OF [redacted]

1. My name is [redacted]. I am of legal age and competent to give this declaration. All of the information herein is based on my personal knowledge unless otherwise indicated.

<u>Background</u>

2. I am [redacted] African American woman. I grew up in North Carolina. My current address [redacted].

3. I have lived at this address for 13 years. I live in a lane with about 12 other homes. I live with my [redacted] husband [redacted], my [redacted] son [redacted], and [redacted], who is my niece's son.

4. Our home is built on land that we own, and we have been paying a mortgage for the past 13 years on the house. This is our property.

5. I used to work as a nurse's assistant, but my husband and I are both retired now.

6. I attend church at Union Grove Church of Christ, 716 Lisbon St., Clinton, North Carolina.

7. I suffer from high blood pressure, thyroid issues, arthritis, several heart conditions, and occasionally use an oxygen machine. My husband had surgery for cancer in 2008, but he is doing much better now. [redacted] regularly sneezes and has a stuffy nose. The doctor says he has allergies, and I worry that it is related to the hog waste.

<u>Experience Living Near Several Hog Facilities</u>

8. There are several hog facilities very close to my home, including one directly north on Bass Lake Road, and one directly south on Bass Lake Road, as shown in the map attached as Exhibit 1. There are at least three hog facilities within a 1 mile radius of my home,

and at least 7 hog facilities within a 3 mile radius of my home. Living near these facilities has negatively impacted me and my family in several ways.

9. The hog facilities have sprayfields near my home. The facilities spray manure out on these fields, which creates a stench.

10. Because of the stench from the hog facilities, which is particularly bad when the facility is spraying manure and in the summertime, my family can no longer have cookouts outdoors. In fact, we hardly ever go outside because of the smell and the flies that the manure attracts.

11. The smell from the facilities lingers around my home, in my car, and even in my mouth and throat. This has caused my throat to feel tight and sore.

12. My family is no longer able to hang clothes out to dry because the smell sticks to the clothing.

13. I used to fish at Bass Lake Pond, about a five minute walk from my home, but I am no longer able to because of the smell and the flies.

14. My Church, Union Grove Church of Christ in nearby Clinton, North Carolina, also has events inside because of the smell.

15. I think that they way these hog facilities affect my community is a civil rights issue. People should not have to smell this kind of thing right on their own front porch, taking away their ability to enjoy the use of their own home.

Executed in Sampson, North Carolina on 8/28/14, 2014 J.L.

[redacted]

EXHIBIT 1


Exhibit 1
Legend
[redacted]
[redacted]
Google earth
© 2014 Google
4000 ft
N

Exhibit 25

DECLARATION OF [redacted]

1. My name is [redacted]. I am of legal age and competent to give this declaration. All of the information herein is based on my personal knowledge unless otherwise indicated.

Background

2. I am a [redacted] African American woman.

3. I live at [redacted] with my husband. We have lived at this address since about 1968. We own our home.

4. I have lived in eastern North Carolina all of my life. I grew up just two doors down from where I currently live.

5. I recently retired from General Electric in Wilmington, North Carolina. I worked in the nuclear division.

6. I attend the Hills County Baptist Church at 2521 Little Kelly Road in Rocky Point.

Experience Living Near Several Hog Facilities

7. There are several facilities that are very close to my home. One is less than a mile away and there are others within two miles. Maps showing my house, the church I attend, and the nearest hog facility are attached as Exhibits 1-2.

8. Beyond my house, in my community, there are even more hog facilities. There used to be nine hog facilities on Five Mile Road, which is also called Little Kelly Road, between Route 210 and Highsmith Road. I'm told now that there are only six hog facilities. It's still a lot of hog facilities on a small stretch of land. A map showing the six hog facilities in my

immediate community is attached as Exhibit 3. A map showing the hog facilities within a 3 mile radius is attached as Exhibit 4.

9. The biggest problem with living near the hog facilities is the smell. I like to be outside. We have a pool, but the stench is so bad that it's not pleasant to be outside and we can't enjoy our pool. If you sit on the front porch, and the wind goes in the certain direction, the stench can hit you full force. We have to be careful to plan our time outside to try to avoid the smell.

10. Because of the smell, there's no such thing as putting the windows down. There's no way to know when the smell will come and hit the house full force.

11. It always smells, but when the hog facilities spray the liquid on the field, there's an extra stench.

12. The smell is also a problem for us at church. We don't like to have the windows open at church for fear of the smell from the hog facilities. We don't like to leave the doors of the church open for the same reason. Because of the smell, we hold events inside. We'd like to have events outside, like a fish fry, but the smell would prevent us from enjoying being outside.

13. My church and the surrounding hog facilities are shown in Exhibit 1, referenced above.

14. I have experienced the smell from these large industrial hog facilities since they came to North Carolina in large numbers. I have always lived in this community and always have been exposed to their pollutants and smell. When I was growing up, I lived two doors down from my current home. The industrial hog facilities are different than the small hog farms of the past. My stepfather had a small farm with hogs, and it didn't smell anywhere near what these big facilities smell like.

15. In addition to the smell, I am also concerned about run-off, especially when the facilities spray the waste on the field. I am concerned that run-off will affect the water. I am on county water now, but before I had well water. I had my water tested about ten years ago. The tests didn't appear to show any impacts from the hog waste, but I was still concerned that runoff could affect water quality. When the county came through with the water, we paid $120 to connect to give us piece of mind. County water has been a Godsend. I feel much more comfortable drinking the water. I am not as worried about pollution from the hog facilities.

16. I have allergies, but I can't be sure whether they have been affected from the hog facilities.

17. My community has suffered a lot of health problems. For a while, it seemed like all we had in this neighborhood was cancer. My mother passed away in 1982 from cancer, and several others out of the neighborhood also passed away from cancer. People who live in this neighborhood have been suspicious that there were so many cancer patients in this area. We wonder if the incidence of cancer could be related to our water. We never had the water throughout our whole area tested, but it has been a topic of conversation among some people in the neighborhood. It seems like fewer people are dying of cancer these days, but I wonder if we might see bouts of cancer again.

18. I think there has to be some other way for the hog facilities to get rid of their waste, and to get rid of the smell.

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Rocky Point, North Carolina on Aug 26, 2014

[redacted]

EXHIBIT 1

EXHIBIT 2

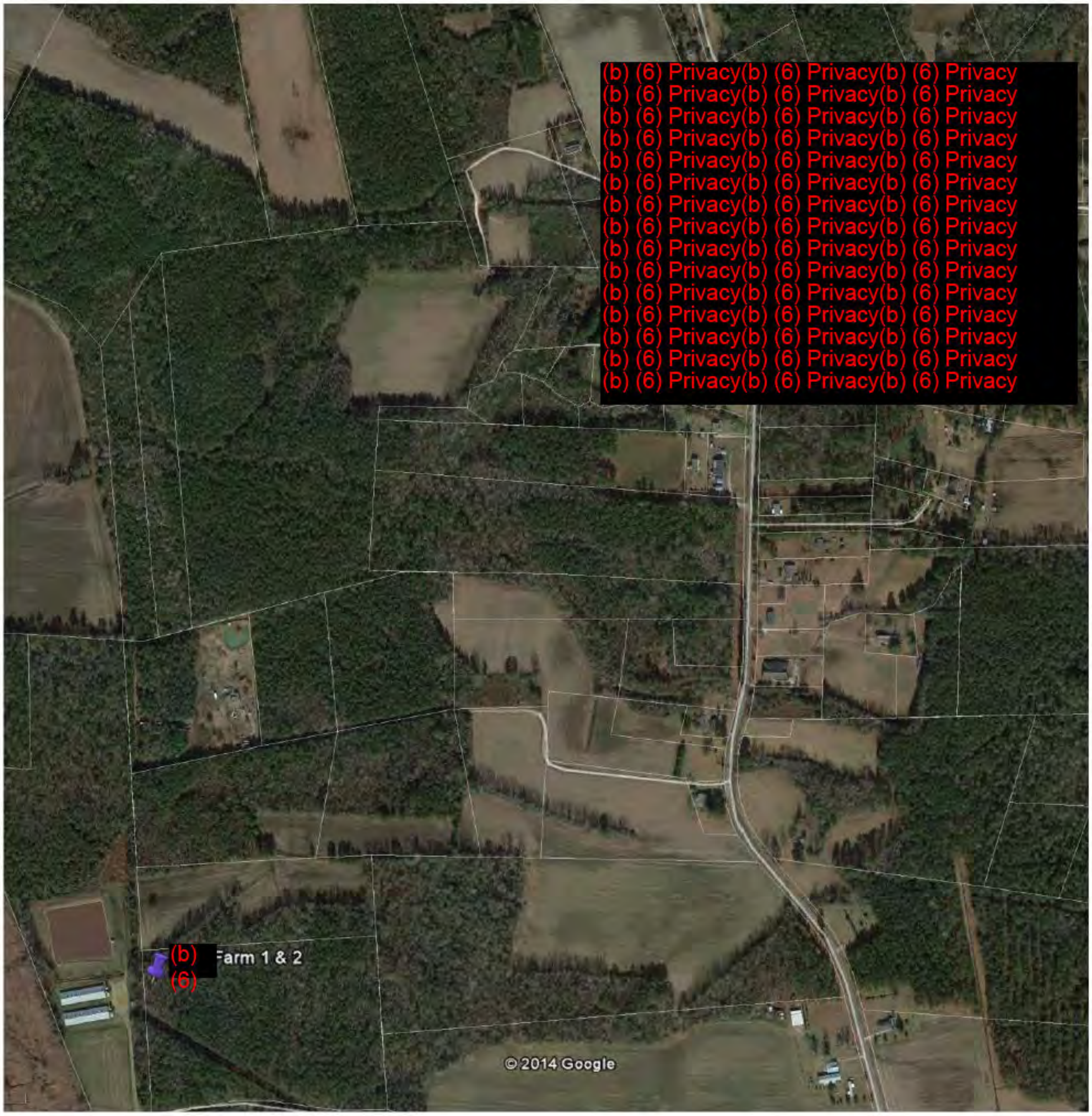


EXHIBIT 3

EXHIBIT 4

NOTE: Map shows locations of swine facilities operating under the General Permit, as indicated in NCDENR's spreadsheet of permitted animal facilities, updated January 10, 2014. Circle shows permitted swine facilities within a 3 mile radius of [redacted] home, as calculated by Google Earth Pro.

Exhibit 26

DECLARATION OF [redacted]

1. My name is [redacted]. I am of legal age and competent to give this declaration. All of the information herein is based on my personal knowledge unless otherwise indicated.

Background

2. I am [redacted]. I currently live with my father at [redacted] in [redacted]. I lived at this address for about 3 years I was in high school, and I moved back last year after I finished college at Eastern Carolina University. I graduated Eastern Carolina with a B.S. in Chemistry in 2013.

3. Before we lived in Clinton, my father, my two brothers, and I lived near the intersection of [redacted] and [redacted] We lived in Delway for about two years before we moved to Clinton.

4. My family moved to Delway, North Carolina from Rio Lindo in Cortes, Honduras in December of 2003, when I was in the eighth grade. When we were in Honduras, my family was poor. We barely had a house when we were little. My father was a farmer and he barely got by planting corn. A family tragedy forced him to move from Honduras to the United States to find a better life for his family. Eventually, my father found his way to North Carolina, where he worked for a chicken farm, and then in carpentry before he was able to send for me and my two brothers.

5. I am currently an [redacted] for the North Carolina Environmental Justice Network ("EJ Network"). I have been working with the EJ Network since April or May of 2014.

6. Since moving to the United States and attending college here, I have become very interested in civil rights and have become involved with grassroots efforts to further civil rights. I am interested in many issues both domestically and internationally. When I learned about the

opening with the EJ Network and the work they were doing to address the inequality in how the hog facilities pollute Hispanic and African American communities in North Carolina, I knew I wanted to be involved. I met with the director of the EJ Network, Naeema Muhammad, and took a position as an organizer.

Personal Experience with Hog Facilities

7. I first experienced hog facilities when I was a freshman at Union High School in Clinton. Back when I attended the high school, between 2004 and 2008, the high school was located on Taylor Bridge Road in Clinton. They recently built a new high school.

8. When I attended Union High School, the school was located near a few hog sprayfields. I remember the first time I saw the facility spraying. I was walking with my brother to his car after we both finished soccer practice. At first, I smelled a terrible odor in the air. As I got closer to the parking lot, I noticed that all of the cars were covered in a fine, sticky mist of hog manure. We got in the car and it stunk all the way on our drive home.

9. The hog facility had a few sprayfields located around the school. They wouldn't always spray on the sprayfields that were close to the soccer fields, but when they did, the waste would coat the cars in the parking lot.

10. I also ran track and field when I was in high school. The school didn't have a track, so during practice they would just have us run around the road that circled the school. On our runs, we would pass by fields where the facility was spraying and we could smell the stench of the hog manure.

11. When I first started high school, I sometimes rode the bus to school. To me, the most upsetting part about living in an area that is surrounded by hog facilities was seeing how many kids were forced to get on the bus stinking of hog waste. If a kid lived near a hog facility,

or if his parents worked in a hog facility, he'd stink of hog waste. When one of these kids would get on the bus, we would be able to smell the hog waste all the way to the school. The stench would get in the kid's clothes and stay there all day. People at my high school never really made fun of each other for smelling like hog waste. Smelling like hog waste was seen as a fact of life, something you couldn't change. So many kids smelled like hog waste that it wasn't really out of the ordinary, but it was still humiliating. I was upset that so many kids were forced to come to school stinking of hog waste.

12. My senior year of high school, I had the opportunity to work at a large scale facility that had both chickens and hogs. It had about 5,000 chickens and about 2,000 hogs that were about 40 or 50 pounds and were being fed to get to slaughter weight. I only worked in the facility for two weeks during the fall, but it was more than enough time for me. Two of my friends got me the job because the facility needed some extra help. The job sounds pretty simple, but it wasn't easy. Every morning, I would go into the chicken and hog houses to check to make sure that the animals had enough water and that their feed was not blocked and was coming out. After checking on the food and water, I would get a clipboard and go around hauling out dead animals and recording the numbers of animals that had died. It was not very hot when I worked at the facility, so not many animals were dying of the heat, like they do in the summer. Even still, I would haul out about eight dead chickens a day, and a few hogs, because of the heat and conditions. Sometimes by the time I pulled out a hog, it was half eaten by another animal. I would throw the dead hogs in the dead box to be disposed of.

13. The hours of the job weren't bad. We worked from about 9 in the morning until about 1 or 2 in the afternoon. But, without a doubt, the job was very rough and hard work.

14. One of the hardest parts of the job was the smell. My clothes and shoes smell terribly of the hog waste. I had to leave my clothes outside of my house because the smell was so bad. I wore the same clothes two or three times so that I didn't have to do the wash every day.

15. Working in the hog facility allowed me to see up close the different ways that animals are raised in the United States and in Honduras. My father was a farmer in Honduras and my uncle owned an animal farm. Growing up, the farm was the place where you saw little piglets running around. The hogs were outside. We'd feed them scraps from the table. In the United States, the hogs were confined and forced to live in small quarters without much light. I don't think we had industrial hog facilities where I lived in Honduras. The industrial hog operations in the United States really shocked me.

16. I have never lived directly next to a hog facility, but my family's homes in Delway and Clinton are not far from hog facilities. At our home in Delway, if we drove down the road, there were two large hog facilities. At our home in Clinton, the nearest hog facility is about 4 or 5 miles away. I can't smell the hog facilities at my home in Clinton, but I can when I am out in the community. Everything around here is surrounded by the hog facilities.

17. Maps showing the location of the hog facilities near my house in Delway, my house in Clinton, and my high school are attached as Exhibit 1-3.

18. I started fishing a few years ago, in 2011. I have fished in many ponds and rivers throughout the state. I notice when the water is dirty from pollution, including runoff from swine facilities. The biggest difference between a healthy pond and an unhealthy one is that the latter is likely to be green with algae.

19. If a pond is not near an industrial animal operation, like a swine facility, the pond is generally cleaner and the fish are normally healthier than when the pond is located near an

industrial animal operation. When I fish in a polluted pond, I am more likely to pull out a fish that has a fungal infection or abrasions on its skin than if I am fishing in a clean pond. It's hard to describe the abrasions, but they are different than when you catch a fish that has been bitten or attacked by another fish. I would like to be able to eat the fish I catch, but there's no way I would eat some of these unhealthy fish that I catch.

20. I like to fish at a pond near me in Clinton. It's located on Tyndall Grove Road, near where Tyndall Grove Road dead ends at Peterson Road. I have been fishing here since May or June of this year. The pond is located near a facility that has hogs and some free range cows that can walk up to the water. I think that runoff from the sprayfields gets into the pond, in addition to some waste from the cows. I have pulled out unhealthy fish from this pond. I like fishing here because it is close to my house, but I know it's not clean.

21. Clinton is affected by another aspect of the hog industry. Near the center of town, Smithfield owns a large processing plant. The whole city stinks when they are processing meat. The smell never makes it all the way to my house, but if I drive just half a mile toward town, I smell it. The smell is extremely bad. The plant usually processes meat late at night and early in the morning. It's just terrible.

<u>My Work with the EJ Network</u>

22. I wanted to work for the EJ Network as an organizer because I wanted to do something to further civil rights and improve the environment.

23. As an [redacted], I focus on educating the community. A lot of people understand that there's a problem with the hog industry, but they cannot identify the problem in scientific terms or with data to support their belief that there's a problem. I give them information about

how the hog facilities affect their health and welfare and help organize events to bring together the community to discuss the problem.

24. In my work as an [redacted], I have focused on communities in Sampson, Duplin, and Pitt Counties. I have met many people who have been personally affected by hog facilities. I have met a lot of Hispanic, black, and low-income people who are suffering because of the hog facilities.

25. Many of the Hispanics who live near hog facilities are hesitant to talk to me about how the hog facilities impact their lives. They often think that there is nothing that they can do to address the problem. They have been treated like second or third class citizens here and often are just hoping to make enough money to move away from the problem.

26. The African Americans who live near hog facilities are more likely to tell me about their experience. Often, they complain about the smell. They tell me that the smell from the facilities is embarrassing and that if their family and friends who don't live near a facility stop by, they don't want to be outside because of the smell. They tell me that they don't like their kids to play outside because of the smell. They often tell me that their water is bad.

27. From speaking with communities that live near hog facilities, I have started to notice some upsetting trends. It seems like a very high percentage of the children in these communities have asthma.

28. I get broken up when I talk to people who have little babies, children who are just three or four years old, who are suffering from the hog facilities. They are so innocent. Life is just starting for them. They want to play outside and be kids, but their parents make them come inside to be away from the hog smell, so that they don't trigger their asthma or other respiratory problems, or get covered in hog waste. I grew up poor with not a lot of food or clean water, but

at least I got a chance to be a kid and play outside. These kids might have food, but they cannot have a life outside of the house, like a normal kid. They don't have some of the freedoms that I had when I was growing up. It really breaks me up and has been personally affecting me.

29. Without a doubt, I think that the way the hog facilities are allowed to affect people is a civil rights issue. From my experience as an organizer and from reviewing scientific studies, I have seen that hog facilities are more frequently placed in Hispanic and African American communities. I think that the hog industry chose to place itself in these communities because they are unlikely to fight back. I believe that a middle class, white community would be able to stop a hog facility from coming in and spraying the waste on them.

30. The Garland community is a good example of how the industry targets disadvantaged communities. In Garland, there is a trailer park on Highway 701. Mostly undocumented Hispanic workers live in the trailer park. People who live in Garland tell me that the trailer park has been there for decades. People in the park tell me that the hog facilities weren't a problem until 1998. Around that time, hog facilities were built behind the trailer park. I looked up the records and two of the hog facilities were built in 1998, one was built in 1999, and the last was built in 2001. Whoever built the hog facilities had to know that most of the people in the park were undocumented Hispanics. Low-income communities of color, particularly undocumented Hispanics, would be less likely to put up much resistance.

31. I think the hog facilities invade people's private property and obstruct their pursuit of happiness. How can you be happy if your house smells of hog manure?

I declare under penalty of perjury that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Executed in Sampson, North Carolina on 8/25/14, 2014

[redacted]

EXHIBIT 1 – Hog Facilities Near [redacted] Home

EXHIBIT 2 – Hog Facilities Near [redacted] Home

EXHIBIT 3

From: [redacted]
To: Title VI Complaints
Subject: Complaint
Date: Friday, April 17, 2015 9:58:53 PM

I bought a 2014 Jeep Grand Cherokee with DEF emissions controls on a road trip with my wife and infant the vehicle has a message that says this vehicle needs DEF service and will not restart after 200 miles. So I get stranded with no vehicle an infant no way to get him food awaiting a tow truck to get my truck to the local dealer 400 miles from home. So how can you justify forcing car manufacturers to put on a stop vehicle for an emissions control devices. This could have caused my wife and infant harm it is a good thing we ran into an elderly couple who gave us a ride from the hotel we were forced to stay and get baby food.The other thing was the tow truck was not sure how to drive us to our hotel without a child seat that was in our jeep.

I wish you would recall this requirement as people will get hurt

FYI - humans are part of the environment and putting them in danger in not protecting the environment.

Sent from my iPad

From: [redacted]
To: Title VI Complaints
Subject: FREON DISCHARGE ON AIR
Date: Wednesday, April 15, 2015 10:06:27 AM

There is demolition taking place at 1900 north Broad Street in Philadelphia and the windows have air conditioning units in them. They are performing demolition without removal releasing freon into the air. (b) (6) Privacy (b) (6) [redacted]

Sent from my iPhone

From:	[redacted]
To:	Title VI Complaints
Subject:	Need Help to file a complaint against this Agency
Date:	Thursday, April 02, 2015 7:00:41 AM

I need help to file a Discrimination Complaint against this Agency
my name Is (b) (6) Privacy [redacted] (b) (6) Privacy [redacted]
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
Sent from Windows Mail